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GEOLOGICAL SURVEY OF ALABAMA
WALTER B. JONES, STATE GEOLOGIST

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BULLETIN 66

GEOLOGY AND GROUND WATER IN THE MONROEVILLE AREA, ALABAMA

By
John B. Ivey
Geologist, United States Geological Survey

Prepared by the
UNITED STATES GEOLOGICAL SURVEY
In cooperation with the
MONROEVILLE WATER BOARD
and the
GEOLOGICAL SURVEY OF ALABAMA

University, Alabama

1957

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LETTER OF TRANSMITTAL

University, Alabama

August 10, 1956

Honorable James E. Folsom
Governor of Alabama
Montgomery, Alabama

Sir:

I have the honor to transmit herewith the manuscript of a report entitled "Geology and Ground Water in the Monroeville Area, Alabama" by John B. Ivey, with the request that it be printed as Bulletin 66 of the Geological Survey of Alabama.

Respectfully,

WALTER B. JONES

State Geologist

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GEOLOGY AND GROUND WATER IN THE MONROEVILLE AREA, ALABAMA

By
John B. Ivey
U. S. Geological Survey

ABSTRACT

This report covers an area of 48 square miles in central Monroe County, Alabama. Aquifers penetrated by wells in the area range in age from Eocene to Recent. Aquifers of Eocene age include the basal part of the Nanafalia formation, the Nanafalia formation and Tuscahoma sand undifferentiated, the Lisbon formation and Gosport sand undifferentiated, and the Ocala limestone. Aquifers of Oligocene age include the Marianna limestone and the Glendon limestone member of the Byram formation. The aquifers of Miocene age have been included with the Citronelle formation of Pliocene age in this report, for convenience in discussion.

The Lisbon and Gosport, Ocala, Marianna, Byram, and Citronelle formations lie at relatively shallow depth. The Citronelle is an aquifer and is penetrated by shallow dug and drilled wells on farms; however, it provides sufficient water for two sawmills also. Wells in the Ocala limestone and the Glendon limestone member of the Byram formation yield sufficient water for domestic use. Municipal wells yield as much as 175 gallons per minute (gpm) from the Marianna limestone, and as much as 140 gpm from the Lisbon and Gosport.

Deep wells can be developed in the Tuscahoma sand and Nanafalia formation undifferentiated and in the basal sand of the Nanafalia formation; at least 900 gpm can be obtained from the basal sand. These are the most promising aquifers in the Monroeville area.

Water from the shallow aquifers has a wide range of chemical characteristics. The Citronelle formation yields water that is low in dissolved solids, soft, but generally high in iron. The water is likely to be somewhat corrosive to metal surfaces. The other shallow aquifers, including the Gosport and Lisbon, usually yield water that is rather hard but otherwise unobjectionable.

Water from wells in the deep sand aquifers of the Tuscahoma sand and Nanafalia formation undifferentiated and of basal sand of the Nanafalia formation is generally of good quality, except that it tends to be quite high in alkalinity and in dissolved solids. The temperature of water from the shallower aquifers is seldom above 70°F; that from the deeper aquifers is usually between 80° and 85°F.

Monroeville completed two wells in water-bearing sands of the Nanafalia formation within the city limits in 1953 and 1955. These wells are 1,410 and 1,216 feet deep, and are reported to yield 900 and 800 gpm, respectively. They supply municipal and industrial water to the city.

INTRODUCTION

PURPOSE OF INVESTIGATION

A detailed investigation of the geology and ground-water resources of the Monroeville area was begun in April 1951 as part of a Statewide program of ground-water investigations being carried on by the United States Geological Survey in cooperation with the Geological Survey of Alabama, Dr. W. B. Jones, State Geologist, and in collaboration with the Monroeville Water Board. The purpose of this investigation was to collect detailed geologic and hydrologic data and to determine the occurrence, availability, and, chemical quality of ground water in the Monroeville area, where critical municipal and industrial water shortages had developed. The results obtained will aid in the future development of ground-water supplies for domestic, farm, industrial, and municipal use.

The investigation, which was completed in 1953, was made under the direct supervision of P. E. LaMoreaux, U. S. Geological Survey, Tuscaloosa, Ala.

PREVIOUS INVESTIGATIONS

The first comprehensive report on the geology of Alabama was published in 1926 by the Alabama Geological Survey in cooperation with the U. S. Geological Survey as Special Report

14, "The geology of Alabama." The section of that report dealing with rocks of Tertiary age, which crop out in the area covered by the present report, was prepared by C. Wythe Cooke of the Federal Survey. He described several rock exposures in the Monroeville area and discussed his concepts of the history of rocks of Tertiary age in the State. The Tertiary area of the geologic map of Alabama was mapped by Cooke.

A map entitled "Geologic map of the Tertiary formations of Alabama" by F. Stearns MacNeil, was published in 1946. It is a reconnaissance map, but is more detailed than the 1926 State geologic map.

A report entitled "Fluoride in the ground water of the Tertiary area of Alabama," by P. E. LaMoreaux, prepared by the U. S. Geological Survey in cooperation with the Alabama Geological Survey and Alabama Department of Public Health, was published in 1948 by the State Survey as Bulletin 59. The report discusses the occurrence of fluoride in water from wells and includes analyses of samples from four wells at Monroeville.

SCOPE OF INVESTIGATION

The field investigation, begun in April 1951 and completed in April 1953, included a detailed well inventory and reconnaissance study of the geology of the area. During this period 95 wells were studied and available information on the construction, yield, pumping equipment, and logs was collected for each well (see pl. 2 and table 1). Depths to water level were measured with a steel tape from fixed measuring points. Samples of water were taken from 14 wells and test holes for chemical analysis (see table 2). The Monroeville Water Board contracted with the Acme Drilling Co. in September 1951 to drill a deep test well to obtain hydrologic information. Drilling and testing were under the supervision of the U. S. Geological Survey. Tests were made by pumping the well with compressed air, and water samples for chemical analysis were collected from the three main aquifers. Sixteen shallow test wells were drilled from January to June 1952 by the Marcus Blair Drilling Co. under contract with the U. S. Geological Survey.

Detailed geologic mapping of a 48-square-mile area around the city was done during the period February to December 1952. Mapping was done on aerial photographs with a scale of approximately 1:20,000. Geologic contacts were mapped in the field where possible and contact lines drawn on the photographs were later modified with the use of a stereoscope. Where the contacts were not observed or were indefinite, they are shown on the geologic map (see pl. 1) by a dashed line.

ACKNOWLEDGMENTS

Appreciation is expressed to many people in the Monroeville area for their cooperation in supplying information which contributed to this report.

The writer is grateful to Marcus Blair and Ed Kearley, who have drilled many water wells in the Monroeville area, and who furnished information concerning them. Acknowledgment is made also to the Humble Oil & Refining Co., and especially to W. C. Blackburn of that company, to the Shell Oil Co., Gulf Oil Corp., and Southern Natural Gas Co., which made available much geologic information gathered by them in the area of this report.

GEOGRAPHY

LOCATION

Monroeville, the county seat of Monroe County, in southwestern Alabama (see fig. 1) is about 75 air miles northeast of Mobile and 85 air miles southwest of Montgomery. It is served east and west by Federal Highway 84 and north and south by State Highways 11 and 47. A good system of graded dirt roads offers easy access to most parts of the area. The St. Louis & San Francisco Railroad station at West Monroeville, a mile southwest of town, and the Louisville & Nashville Railroad station at Monroeton, 2 miles east of town, connect Monroeville with other towns and cities to the north and south. Adequate communication facilities are available, and a telephone exchange is located in the city.

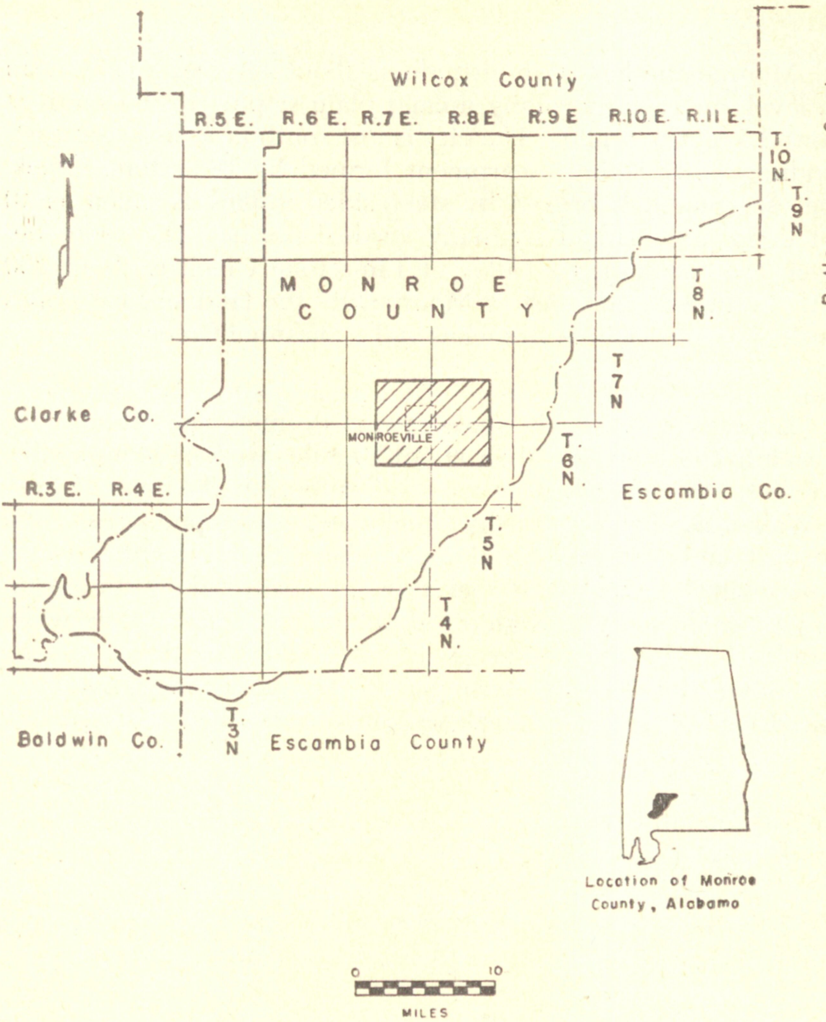

Wilcox County
R.5 E.
R.6 E.
R.7 E.
R.8 E
R.9 E
R.10 E.
R.11 E.
T. 10 N.
T. 9 N
Butler County
N
MONROE COUNTY
T 8 N.
T 7 N
Clarke Co.
MONROEVILLE
T. 6 N.
Escambia Co.
R.3 E.
R.4 E.
T. 5 N
T 4 N.
T. 3 N
Boldwin Co.
Escambia County
Location of Monroe County, Alabama
0
10
MILES

Figure — 1. — Index map showing Monroeville area

TOPOGRAPHY AND DRAINAGE

Monroeville lies at an altitude of about 400 feet above mean sea level, on a gently rolling upland plain sloping to the south at about 3.5 feet per mile. The city is just south of a dissected east-trending, north-facing escarpment formed by Limestone Creek. The escarpment is broken by steep-sided gullies as much as 40 feet deep and marked by many vertical bluffs. The relief between the city and the valley of Limestone Creek is about 200 feet. Southwest and east of Monroeville the land surface slopes gently down to Double Branches and Limestone Creek.

Limestone Creek, the main stream draining the report area, flows into the Alabama River about 10 miles west of Monroeville. The river also forms most of the western border of Monroe County. Walker Branch and Brushy Creek enter Limestone Creek from the east and northeast at Renson, about 3 miles northeast of Monroeville. Limestone Creek flows westward along the northern part of the area through a flat valley about half a mile wide. Double Branches has its origin about 3 miles southwest of the city, drains the southwestern part of the area, and flows into Limestone Creek 4 miles northwest of Monroeville.

CLIMATE

Monroeville lies in the southern climatic division of Alabama below latitude 31°30′ (Hambidge, et al., 1941, p. 760). The subtropical climate of hot summers and mild winters is controlled largely by the nearness to the Gulf of Mexico.

Continuous weather records are kept by the U. S. Weather Bureau at Frisco City about 6 miles southwest of Monroeville. Precipitation records are available at this station for the 23-year period, 1930 through 1952, and temperature records for the 4-year period, 1949 through 1952.

Rainfall constitutes nearly all the precipitation in this area. The average annual precipitation for the 23-year period of record at the Frisco City station is 55.58 inches. The highest average monthly precipitation, about 6 inches, occurs in July, and the lowest, about 3 inches, occurs in October and November (see fig. 2A. The longest periods of deficient rainfall from 1949 through 1952 were the 5-month periods, October 1949 through February 1950, and October 1950 through February 1951, when deficiencies of 10.66 and 8.89 inches respectively, were recorded. Serious water shortages followed these periods of prolonged deficient rainfall. (See fig. 2B for graph of water level in an observation well, showing the decline due to drought.)

The highest average monthly temperature for the 4-year period of record, 84.4°F, was in August 1951; the lowest, 46°F, was recorded in December 1950. Figure 3 summarizes the temperature data for 1952. The growing season in the Monroeville area between the first and last freezes of the year is about 230 days.

HISTORY, POPULATION, AND DEVELOPMENT

Monroe County was one of the first constituted and at one time was one of the largest counties in Alabama. It contained all the lands ceded by the Creek Indians in the Treaty of Fort Jackson on August 9, 1814. According to Brewer (1872, p. 433), the area included:

"all the country east of the ridge dividing the waters of the Alabama and Cahaba from the Tombikbee and Tuskaloosa rivers; south of the mountains of Blount and St. Clair; north of the present boundary line of the State, and west of the Coosa and the line southeast from Wetumka to a point below Eufaula; or nearly half of the present area of the State."

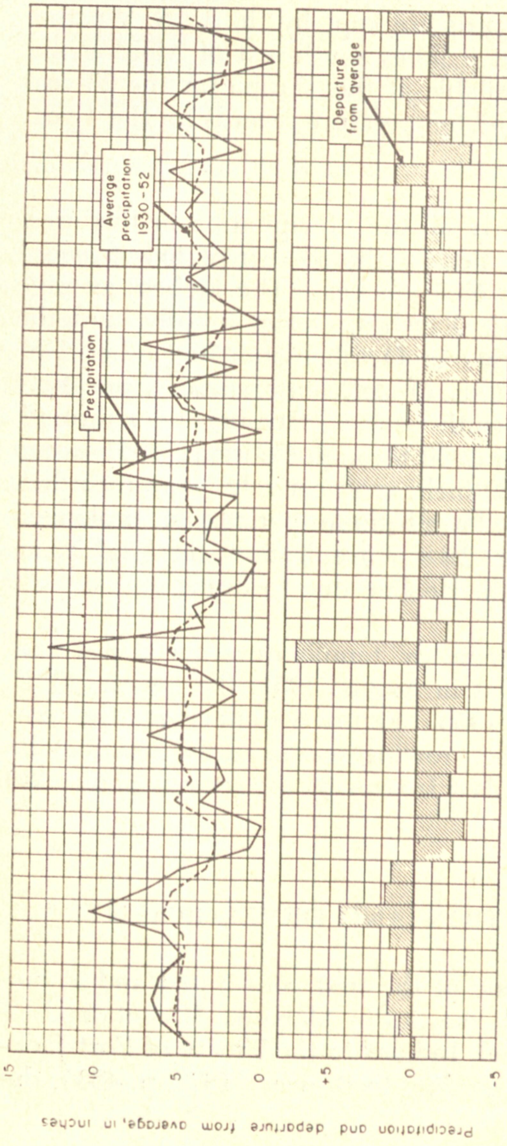


Figure 2A – Graph showing precipitation at Frisco City, 1949-52

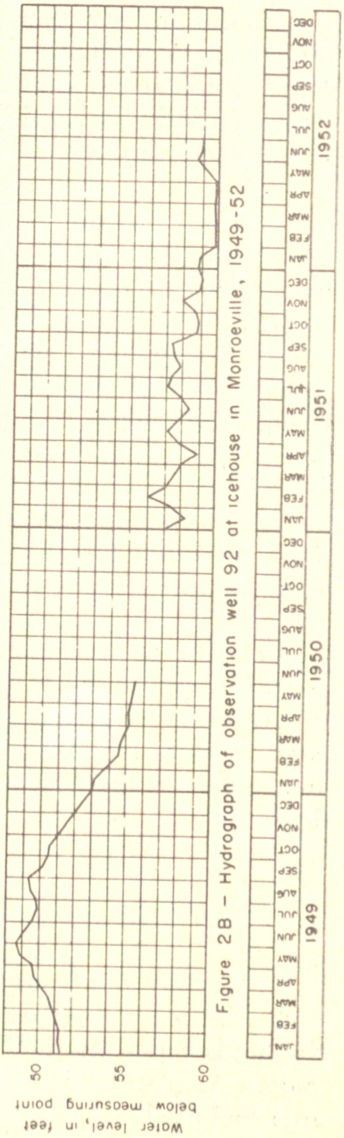


Figure 2B – Hydrograph of observation well 92 at icehouse in Monroeville, 1949-52

This was hard-won land and many men, white and Indian, perished before the Treaty of Fort Jackson made an end to the Creek Wars. The vast area included in the original Monroe County was later divided into many smaller counties. According to the 1950 census, Monroe County had an area of 1,035 square miles.

A comparative graph of the changes in population of Monroeville and Monroe County for most of the 10-year intervals

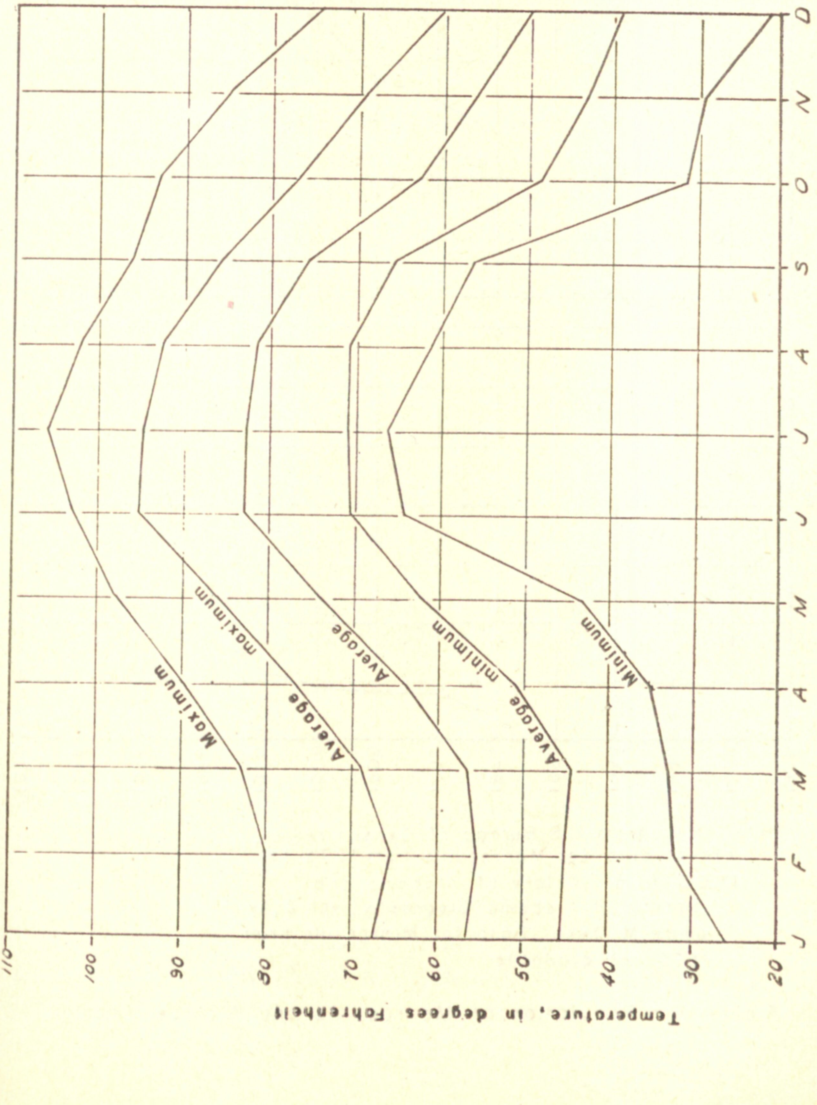
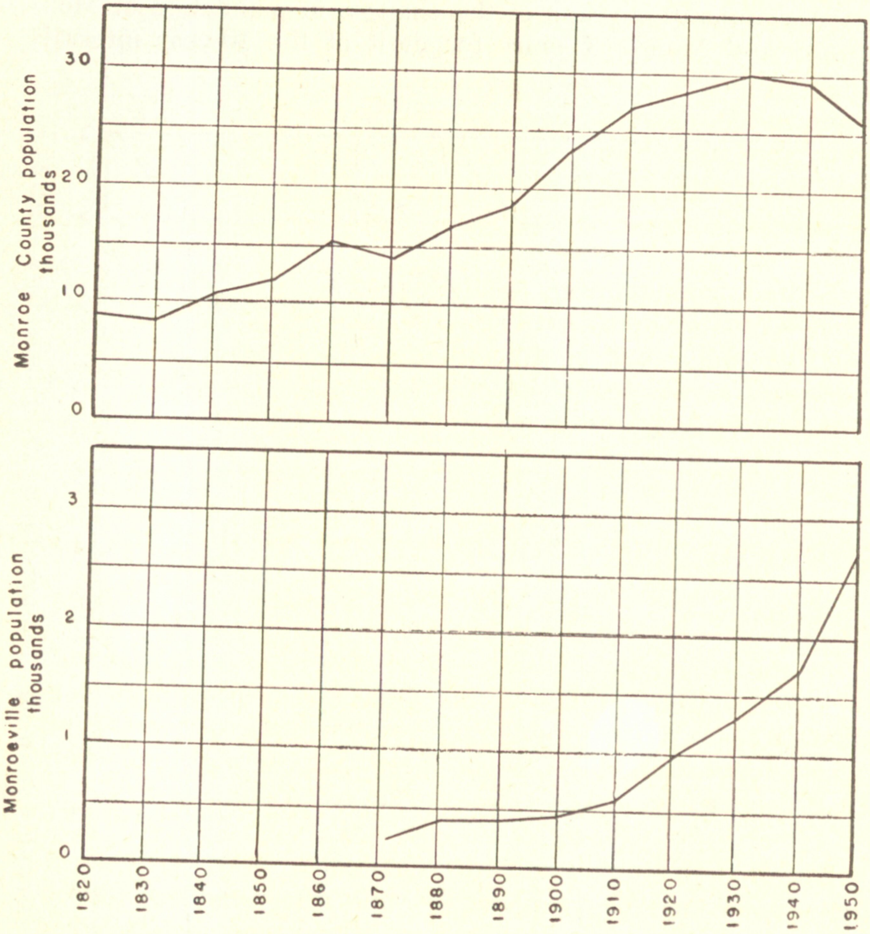


Figure 3. - Graph showing temperature at Frisco City, 1952

since 1820 is shown in Figure 4. The population of Monroe County has always been predominantly rural. Until recently the population of the county and of Monroeville had increased with each census; however, the county population began to decline in 1930. Claiborne was the main trading center of the county until after the Civil War, and Monroeville was a small



Note Data from U S Bureau of Census report, except data for Monroeville from 1872 to 1900 from "History of Alabama and Dictionary of Alabama Biography", vol. 2, by Thomas M Owen Data for Monroeville prior to 1872 not available

Figure 4 - Population of Monroeville and Monroe County

village, although the county seat had been moved from Claiborne to Monroeville in 1832. Monroeville grew in importance after the Reconstruction period and since the turn of the century a gradual increase in population has accompanied the city's growth as a trade and industrial center.

Agriculture is the principal industry of Monroe County, and cotton and corn are the main crops. The central location of Monroeville in the county makes it the most important city and trading center for the agricultural population. Cotton is brought to Monroeville from various parts of the county for ginning and sale. Numerous service companies and department stores in Monroeville meet the needs of the town and farm population.

Textile manufacturing is the largest industry in Monroeville; several hundred people, mostly women, are employed in the textile mill. Several sawmills, lumber companies, and related industries are located in or near the city. A large part of the banking in Monroe County is done, or is controlled, in Monroeville.

HISTORY OF THE MONROEVILLE MUNICIPAL WATER SUPPLY

In the early days, people of Monroeville could get sufficient water from springs in the gullies near town and from shallow wells. As the population grew and the per-capita use of water increased, more wells were dug or old ones were drilled deeper.

The first public system was installed in 1900. It was privately owned and was supplied by two reservoirs, one fed by surface runoff, the other by a spring. Water was impounded in two ravines by dams and was pumped a short distance southeast to the town, where it was stored in a 50-foot elevated tank north of the courthouse. Sometime between 1900 and 1906 the owner of the system drilled two shallow wells and built another 50-foot elevated tank about a block east of the courthouse near what is now Claiborne Street.

This water system was purchased by the town in 1906. After fire destroyed one of the storage tanks in 1906, a new 75-foot elevated tank was constructed, and 1,500 feet of 6-inch water mains and 3,000 feet of 2-and 3-inch branch lines were installed. About 110 customers were served by this system. In 1923 the town sold the system to two individuals.

In 1927 a brokerage firm in Chicago bought the water system, and meters were installed for the first time. The Alabama Power Co. bought the system about 1929 and operated it until 1945, when the city repurchased it.

Figure 5 shows the amount of water used in Monroeville during the period 1948-52; the amount used has fluctuated, but the general trend has been upward. The textile mill consumes about half the total water purchased from the system.

GROUND WATER

SOURCE

Ground water is the water below the water table that may be pumped from wells or flows fom springs. In the Monroeville area ground water is derived entirely from precipitation consisting almost solely of rain that falls on the land surface. Part of the water evaporates into the atmosphere, part flows into streams and lakes as surface runoff, and part percolates downward through the soil and rocks to become ground water, later to be discharged by seepage into surface-water bodies or by evapotranspiration.

Water entering the soil first percolates downward through the zone of aeration (see fig. 6), which contains vadose, or suspended, water. Part of this water is removed from the ground by plant roots and is transpired. Part remains in capillary and subcapillary openings held by molecular forces between grains and in cracks in the rocks in the zone of aeration. The rest percolates downward until it reaches the zone of saturation and becomes ground water.

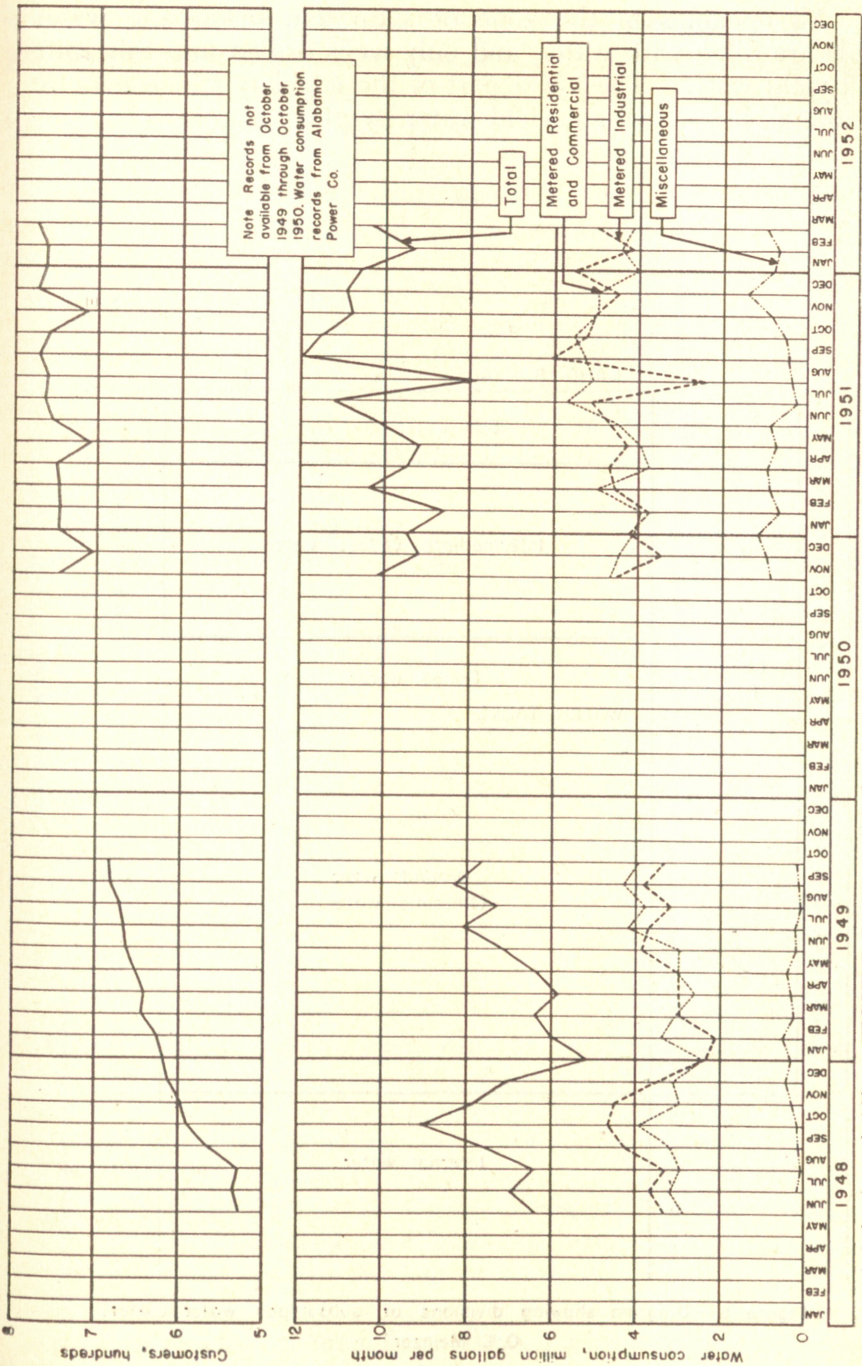


FIGURE 5.—Water consumption in the city of Monroeville, 1948-52.

All openings in the zone of saturation below the water table are filled with water, and only wells drilled into this zone will yield water. The lower part of the capillary fringe may be saturated, but it will not yield water by gravity.

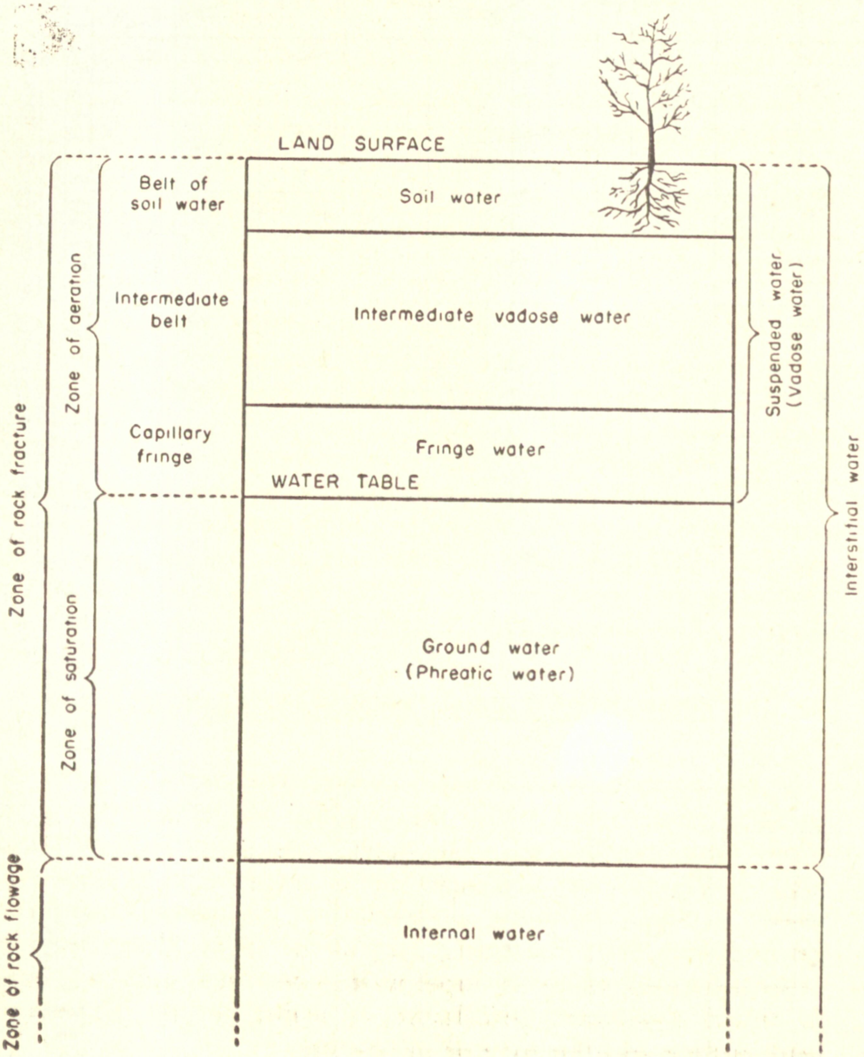

LAND SURFACE
Belt of soil water
Soil water
Intermediate belt
Intermediate vadose water
Capillary fringe
Fringe water
WATER TABLE
Ground water (Phreatic water)
Internal water
Zone of aeration
Zone of saturation
Zone of rock fracture
Zone of rock flowage
Suspended water (Vadose water)
Interstitial water

Figure 6 - Diagram showing divisions of subsurface water. (after O. E. Meinzer)

OCCURRENCE AND STORAGE

Ground water occurs in the zone of saturation in pores, fractures, fissures, and solution cavities in the rocks of the earth's crust. The size, shape, and distribution of these openings vary considerably from place to place, and thus affect the occurrence and storage of ground water.

The porosity of a rock is its property of containing voids. It is the amount of open or void space in a rock and is usually expressed as the percentage of the total volume of the rock. The size, shape and arrangement of particles, degree of assortment, compaction and cementation, amount of fracturing, and amount of solution and recrystallization in the rocks determine the porosity.

The permeability of a rock is its ability to transmit water under hydrostatic pressure. It may be expressed as the rate of discharge of water through a unit cross-sectional area of the rock under a hydraulic gradient of unity. Clay may have a high porosity but a low permeability because of the small size of the open spaces. Gravel and sand beds may have large interconnected open spaces and therefore a high permeability. A cavernous limestone may have an extremely low overall porosity, but the connected solution cavities allow free passage of water, and therefore the permeability is high.

WATER-TABLE AND ARTESIAN CONDITIONS

The water table is defined as the upper surface of the zone of saturation except where this surface is confined by a relatively impermeable bed. The water table is not level or stationary. Its fluctuations and variations in slope occur in response to many factors, including precipitation, pumping, topography, geologic structure, and stratigraphy of the rocks. A perched water table is formed where an impermeable bed with sufficient extent to retard downward percolation of water occurs between the land surface and the zone of saturation.

Artesian or confined conditions occur where water moves through inclined permeable beds and becomes confined above and below by impermeable beds. The pressure exerted on the ground water in a confined aquifer by the weight of water at higher levels in the aquifer is known as hydrostatic pressure. When a well penetrates the overlying confining bed and enters a confined aquifer downdip from its outcrop, hydrostatic pressure causes the water to rise above the base of the confining layer (see fig. 7). The imaginary surface to which artesian water will rise in tightly cased wells is known as the piezometric surface.

The pressure head is the height of water that can be supported by hydrostatic pressure in a well. Where the pressure head is great enough or the land surface is low enough, artesian flowing wells can be obtained (see fig. 7).

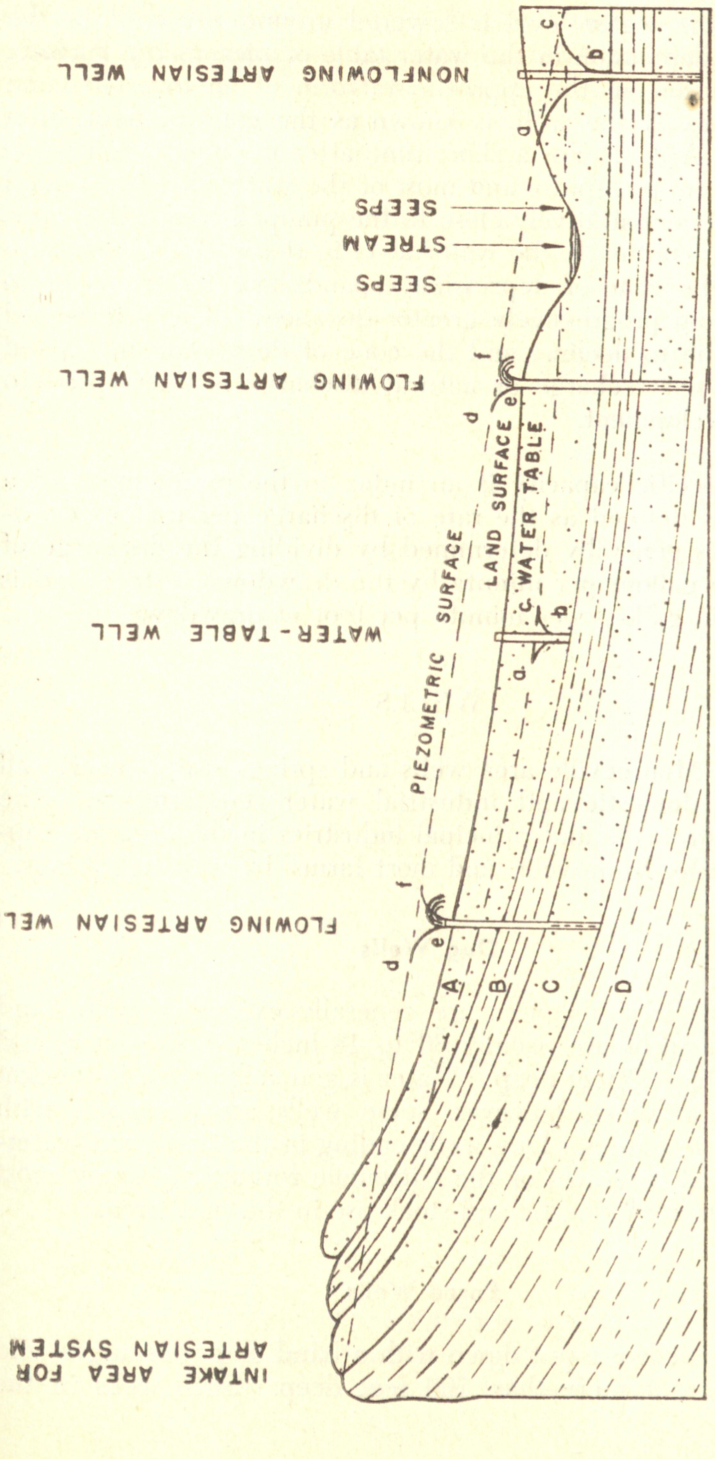
EFFECT OF PRECIPATATION ON WATER LEVELS

Water levels in shallow wells fluctuate primarily in response to infiltration from precipitation and discharge by natural drainage or artificial withdrawal. In the Monroeville area they are generally highest during the early winter and late spring, and lowest during the fall (see fig. 2B). The intensity and duration of rainfall and the permeability of the soil and underlying rocks affect the amount of water that infiltrates as recharge to cause variations in water levels. The best recharge conditions usually occur with moderately intense rains of long duration. Heavy downpours of short duration afford little opportunity for maximum recharge because most of the water not retained in the soil is lost to surface runoff.

Deficiencies in precipitation were recorded for 25 of the 39 months from October 1949 through December 1952 (see fig. 2A). During this period the water level in well 92 (see fig. 2B) at the icehouse in Monroeville gradually declined.

RECOVERY OF WATER FROM WELLS

Withdrawal of water from the zone of saturation through a well creates a difference in head between the water in the well and that in the enclosing aquifer. As a result of such withdrawal a hydraulic gradient from all directions is established toward the


INTAKE AREA FOR ARTESIAN SYSTEM
FLOWING ARTESIAN WELL
WATER-TABLE WELL
FLOWING ARTESIAN WELL
NONFLOWING ARTESIAN WELL
SEEPS
STREAM
SEEPS
PIEZOMETRIC SURFACE
LAND SURFACE
WATER TABLE
A
B
C
D
a
b
c
d
e
f

A Permeable surficial material B Upper confining bed C Artesian aquifer D. Lower confining bed

abc Cone of depression caused by pumping def Cone of depression caused by natural flow

Figure 7.—Schematic diagram showing artesian and water-table conditions.

well, and the water level is lowered around the well in the shape of a depression in the water table or piezometric surface. This depression, in the approximate form of an inverted cone with its apex at the well, is known as the cone of depression (see fig. 7, ABC). For a short time after pumping begins, the water level drops rapidly and most of the water that is pumped comes from comparatively close to the pumped well. However, as pumping continues, the water level in the well declines more slowly as the cone of depression expands and water moves to the well from progressively greater distances. The water level will continue to decline, and the cone of depression to expand until sufficient recharge or natural discharge is intercepted to halt its development.

The specific capacity is an index to the productivity of a well, and is defined as the rate of discharge per unit of drawdown. It is generally determined by dividing the discharge of the well in gallons per minute by the drawdown in feet, and is expressed in gallons per minute per foot of drawdown.

WELLS

In the Monroeville area wells and springs supply nearly all municipal, domestic and industrial water requirements. The city of Monroeville and principal industries in the area are supplied by water from wells, and most farms, by wells or springs.

Dug Wells

Dug wells in the area are generally excavated with hand tools. The wells are usually 36 to 48 inches in diameter, and not more than 60 feet deep. Water is generally lifted by bucket and hand windlass; however, some wells are equipped with small electric pumps. Dug wells ending in the first good water-bearing sand or gravel of the Citronelle formation supply most of the water for domestic and stock use in the rural area.

Bored Wells

Bored wells are put down with a hand or power auger, and are usually not more than 100 feet deep. Such wells in the

Monroeville area are generally finished with a wood curbing about 9 inches square, to the total depth of the well. Water is lifted by bucket and hand windlasses or small electric pumps.

Driven Wells

A driven well is constructed by driving a pipe with a screened drive point at the bottom, down into shallow, unconsolidated water-bearing sand and gravel. The well is generally started with a post-hole digger or auger and the casing is driven in sections. Additional sections of casing are added as the well is deepened. In general only soft material can be penetrated by this type of well.

Drilled Wells

A drilled well is put down by either the percussion or the rotary drilling methods. Casing is set in the well with screens opposite water-bearing sand beds. Wells of this type are of major importance in the Monroeville area, as they furnish all of the municipal and industrial water supplies. Most drilled wells at Monroeville range in depth from 40 to about 500 feet. However, since this investigation and on the basis of information gathered during it, the city of Monroeville has constructed two deep drilled wells drawing water from the basal sand of the Nanafalia formation at depths of about 1,200 to 1,400 feet.

Cable-Tool Method

The cable-tool or percussion-type drilling rig consists of a mast, drawworks, cable, drilling tools, bailer, and power unit. A walking beam moves the cable up and down, causing the bit to break or crush the material at the bottom of the hole. The broken and crushed material is removed with a bailer. This method is used successfully in the Monroeville area, except where caving material is encountered that is difficult to case off.

Rotary Method

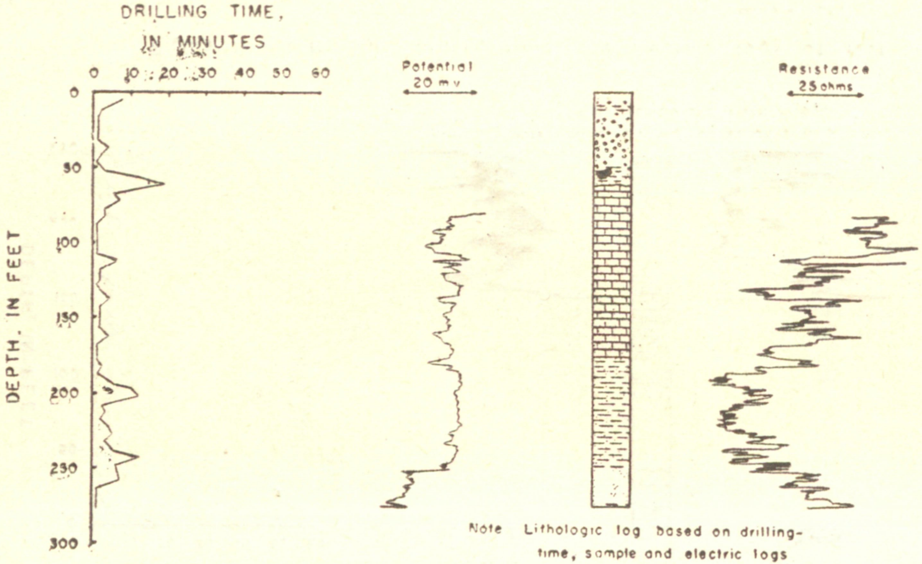
The hydraulic rotary well-drilling equipment consists of a derrick, cables, and reels for handling tools and casing, a rotary table for rotating the drill pipe and bit, and a pump to circulate the drilling fluid. A bit is rotated on the end of the hollow drill pipe through which drilling mud is pumped under pressure and as the bit cuts through the formations the cuttings are carried by the drilling mud up the outside of the drill pipe and out of the hole. The drilling mud also prevents the hole from caving before casing and screen can be set. Wells in the Monroeville area are drilled most easily by the rotary method.

SPRINGS

Numerous small springs, which supply water for one or two farm families or a few head of stock, occur in the vicinity of Monroeville. Springs issue where the land surface intersects the water table (see fig. 7). In the Monroeville area many springs issue from permeable sand and gravel at contacts with underlying relatively impermeable clay. The water moves down though the sand and gravel until it reaches the clay, and then is deflected laterally until it intersects the land surface. Such springs generally rise from the Citronelle formation at contacts of permeable sand and gravel with impermeable clay, or at the contact of the Citronelle formation with underlying relatively impermeable limestone or residual clay above the limestone.

TEST DRILLING

A deep test well, DT-1, was drilled in the NW¼SE¼ sec. 3, T. 6 N., R. 7 E., to determine the lithologic character, hydrologic properties, and quality of water in the Gosport sand and Lisbon formation undifferentiated, the Tuscahoma sand, and a basal sand in the Nanafalia formation. The data obtained from this test well are shown graphically on plate 3. Sixteen shallow test wells, ST-1 to ST-16, were drilled in the Monroeville area (see pl. 2) to collect hydrologic and geologic information on formations of Eocene to Pliocene age. The data obtained from these shallow test wells are shown graphically on figures 8-21.



Note Lithologic log based on drilling-time, sample and electric logs

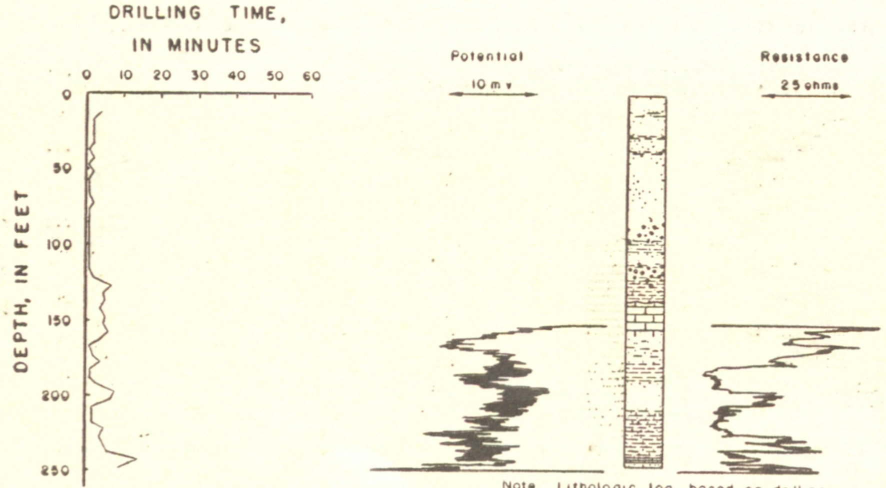
GEOLOGIC SUMMARY

	Depth, feet	Thickness, feet
Citronelle formation	60	60
Vicksburg group	122	62
Red Bluff clay (including phosphatic zone)	135	13
Ocala limestone	173	38
Yazoo clay	235	62
Moodys Branch formation	245	10
Gosport sand	250	5
Lisbon formation	275	25

PRINCIPAL AQUIFERS

Citronelle formation
Gosport sand

Figure 8.- Lithologic, drilling-time, and electric logs of test well, ST-1, showing principal aquifers in NE 1/4 NW 1/4 sec 11, T 6N, R 7E



Note Lithologic log based on drilling-time, sample and electric logs

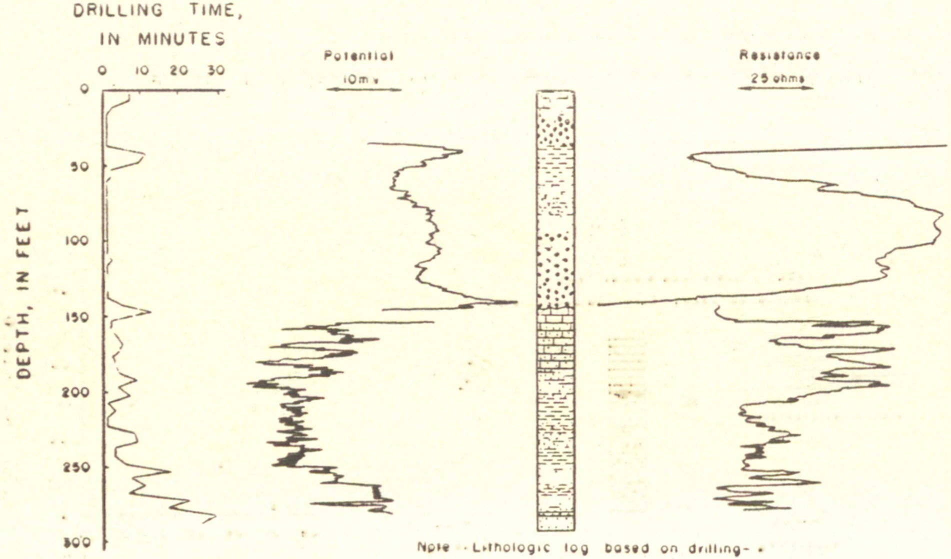
GEOLOGIC SUMMARY

	Depth, feet	Thickness, feet
Citronelle formation	137	137
Red Bluff clay	145	8
Ocala limestone	175	30
Yazoo clay	235	60
Moodys Branch formation	243	8
Gosport sand	247	4

PRINCIPAL AQUIFERS

Citronelle formation
Gosport sand

Figure 9.- Lithologic, drilling-time, and electric logs of test well ST-2, showing principal aquifers in NE 1/4 SW 1/4 sec 11, T6N, R7E



Note - Lithologic log based on drilling-time, sample and electric logs

GEOLOGIC SUMMARY

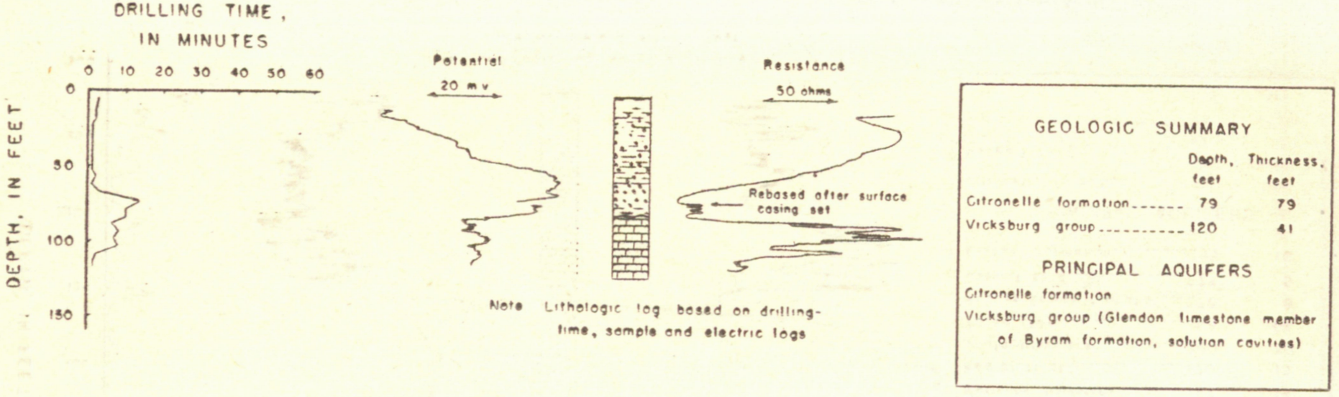
	Depth, feet	Thickness, feet
Citronelle formation	143	143
Marianna limestone	157	14
Red Bluff clay	170	13
Ocala limestone	200	30
Yazoo clay	264	64
Moodys Branch formation	272	8
Gosport sand	277	5
Lisbon Formation	293	16

PRINCIPAL AQUIFERS

Citronelle formation

Gosport sand

Figure 10 - Lithologic, drilling-time, and electric logs of test well ST-3, showing principal aquifers in SW 1/4 SW 1/4 sec 6, T 6N, R 8E



GEOLOGIC SUMMARY

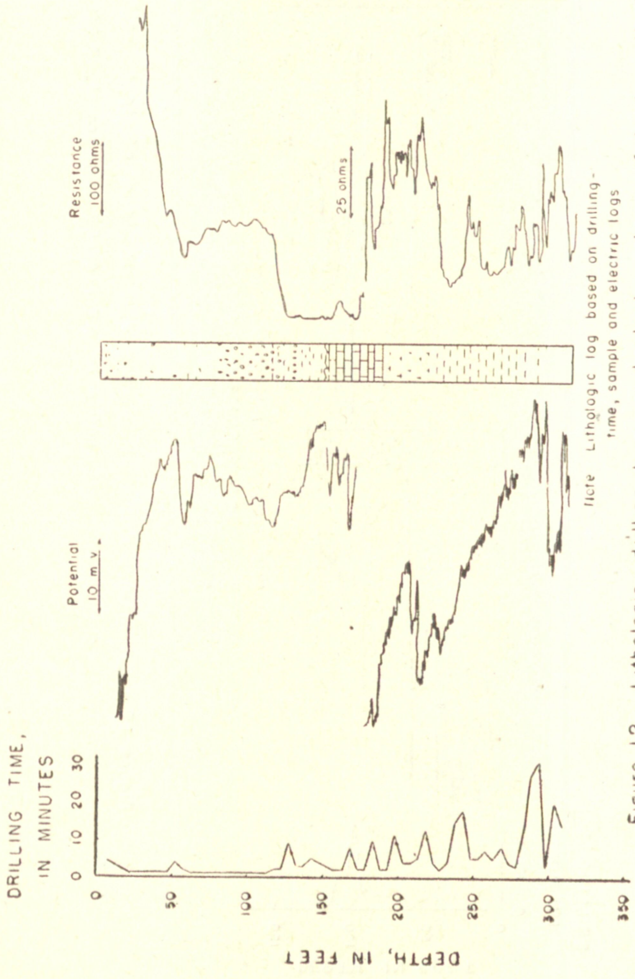
	Depth, feet	Thickness, feet
Citronelle formation	79	79
Vicksburg group	120	41

PRINCIPAL AQUIFERS

Citronelle formation

Vicksburg group (Glendon limestone member of Byram formation, solution cavities)

Figure 11 – Lithologic, drilling-time, and electric logs of test well ST – 4, showing principal aquifers in NW 1/4 NW 1/4 sec 7, T 6 N, R 8 E



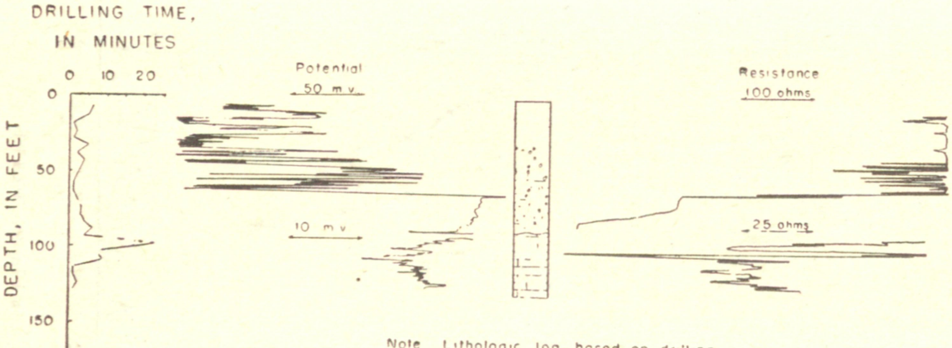
GEOLOGIC SUMMARY

	Depth, feet	Thickness, feet
Citronelle formation	147	147
Marianna limestone	170	23
Red Bluff clay	183	13
Ocala limestone	218	35
Yazoo clay	278	60
Moodys Branch formation	294	16
Gosport sand	305	11
Lisbon formation	310	5

PRINCIPAL AQUIFERS

Citronelle formation
Gosport sand

Figure 12 - Lithologic, drilling-time, and electric logs of test well ST – 5, showing principal aquifers in NW 1/4 SE 1/4 sec 12, T. 6N, R 7E



Note Lithologic log based on drilling-time, sample and electric logs

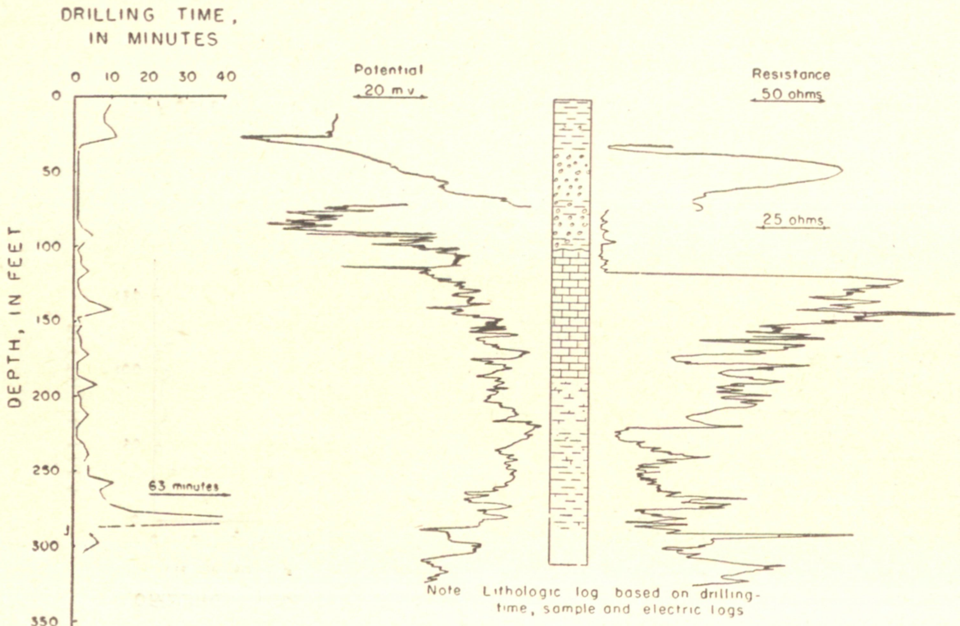
GEOLOGIC SUMMARY

	Depth, feet	Thickness, feet
Citronelle formation........	89	88
Vicksburg group............	130	42

PRINCIPAL AQUIFERS

Citronelle formation
Vicksburg group (Glendon limestone member of Byram formation)

Figure 13 - Lithologic, drilling-time, and electric logs of test well S.T - 6, showing principal aquifers in SE 1/4 SE 1/4 sec 1, T 6N, R 7E



Note Lithologic log based on drilling-time, sample and electric logs

GEOLOGIC SUMMARY

	Depth, feet	Thickness, feet
Citronelle formation	100	100
Marianna limestone	160	60
Red Bluff clay	172	12
Ocala limestone	210	38
Yazoo clay	268	58
Moodys Branch formation	280	12
Gosport sand	288	8
Lisbon formation	320	32

PRINCIPAL AQUIFERS

Citronelle formation
Gosport sand

Figure 14 - Lithologic, drilling-time, and electric logs of test well ST-7, showing principal aquifers in NE 1/4 SW 1/4 sec 1, T 6N, R 7E

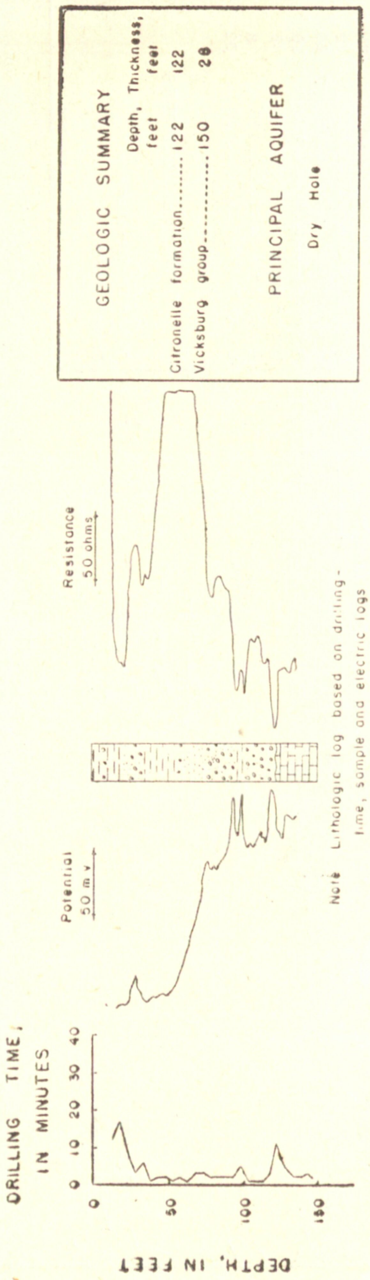
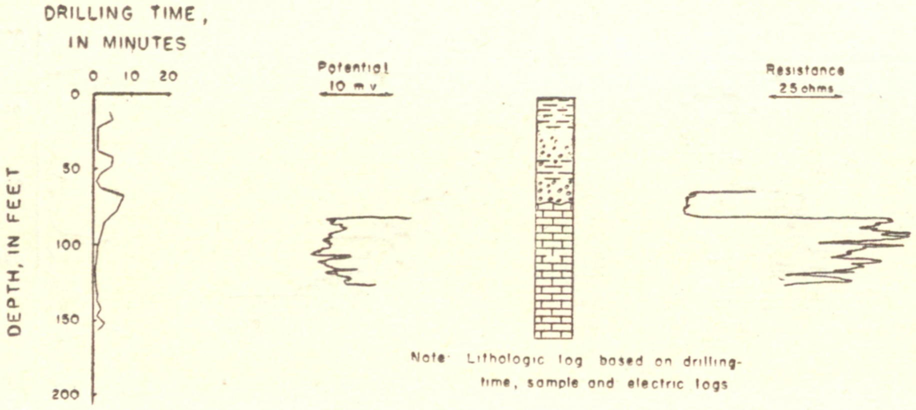


Figure 15.- Lithologic, drilling-time, and electric logs of test well ST-8, showing principal aquifers in SE 1/4 NE 1/4 sec 2, T 6N., R.7E



Note: Lithologic log based on drilling-time, sample and electric logs

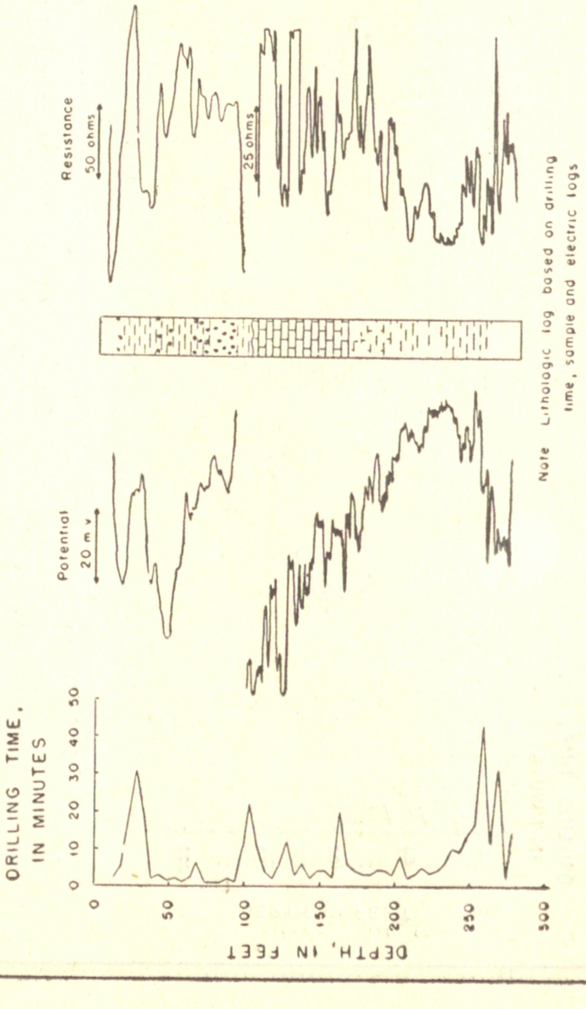
GEOLOGIC SUMMARY

	Depth, feet	Thickness, feet
Citronelle formation........	70	70
Marianna limestone(?)	160	90

PRINCIPAL AQUIFER

Limestone solution cavities from 85 to 135 ft.

Figure 16.- Lithologic, drilling-time, and electric logs of test well ST-9, showing principal aquifers in NE 1/4 NW 1/4 sec 2, T 6 N, R. 7 E.



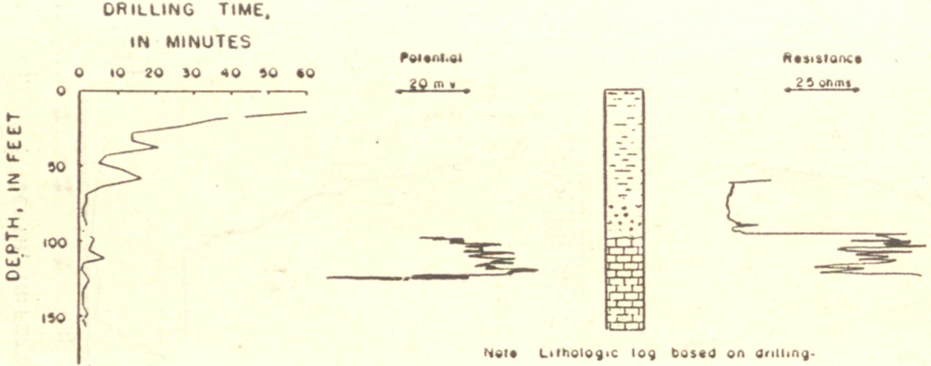
GEOLOGIC SUMMARY

Citronelle formation	99	99
Marianna limestone	140	41
Red Bluff clay	153	13
Ocala limestone	192	39
Yazoo clay	250	58
Moodys Branch formation	258	8
Gosport sand	265	7
Lisbon formation	280	15

PRINCIPAL AQUIFERS

Citronelle formation
Gosport sand

Figure 17 - Lithologic, drilling-time, and electric logs of test well ST-10, showing principal aquifers in NW 1/4 NE 1/4 sec 2. T 6N, R 7E



Note Lithologic log based on drilling-time, sample and electric logs

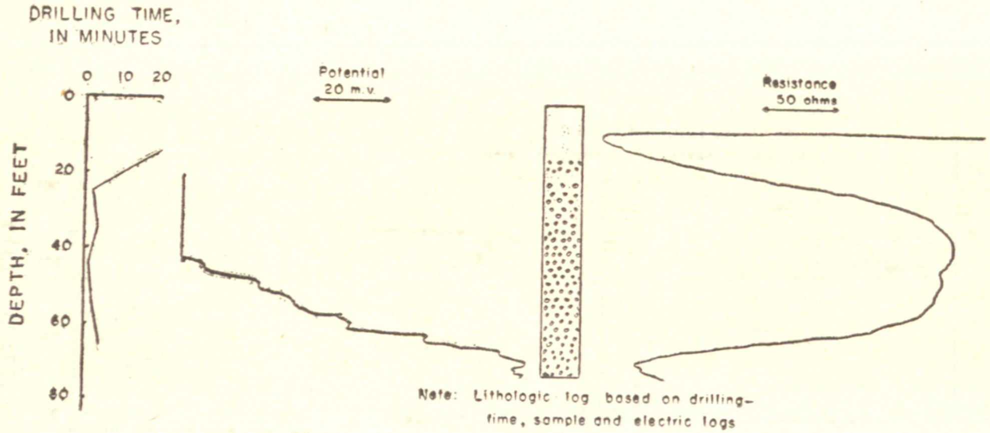
GEOLOGIC SUMMARY

	Depth, feet	Thickness, feet
Citronelle formation........	98	98
Marianna limestone	160	62

PRINCIPAL AQUIFER

Limestone solution cavities from 100 to 128 feet

Figure 18 - Lithologic, drilling-time, and electric logs of test well ST - 11, showing principal aquifers in NE 1/4 NW 1/4 sec 2, T 6N, R 7E



Note: Lithologic log based on drilling-time, sample and electric logs

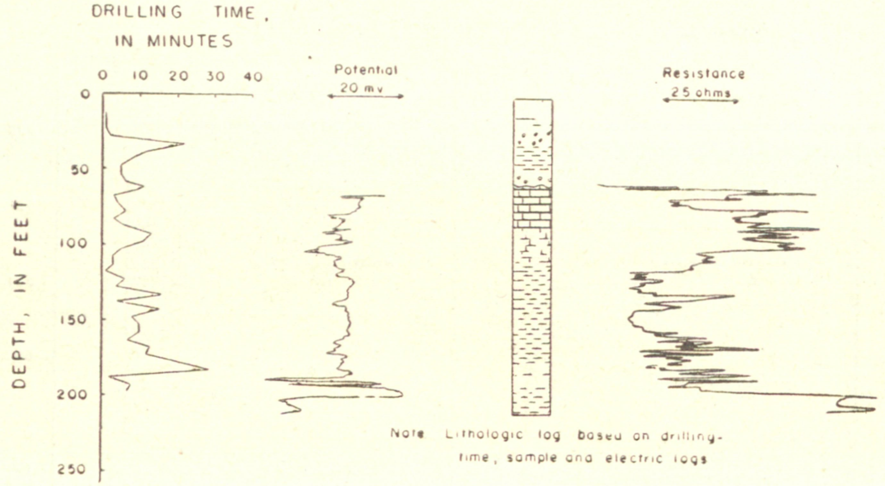
GEOLOGIC SUMMARY

	Depth, feet	Thickness, feet
Citronelle formation.......	72	72

PRINCIPAL AQUIFER

Citronelle formation

Figure 19.- Lithologic, drilling-time, and electric logs of test well ST-14, showing principal aquifers in NE 1/4 NW 1/4 sec 1, T6N, R7E



Note Lithologic log based on drilling-time, sample and electric logs

GEOLOGIC SUMMARY

	Depth, feet	Thickness, feet
Citronelle formation	62	62
Marianna limestone	67	5
Red Bluff clay	79	12
Ocala limestone	106	27
Yazoo clay	175	69
Moodys Branch formation	182	7
Gosport sand	190	8
Lisbon formation	210	20

PRINCIPAL AQUIFERS

Citronelle formation
Gosport sand

Figure 20 Lithologic, drilling-time, and electric logs of test well ST-15, showing principal aquifers in SE 1/4 NE 1/4 sec 25, T 7N, R 7 E.

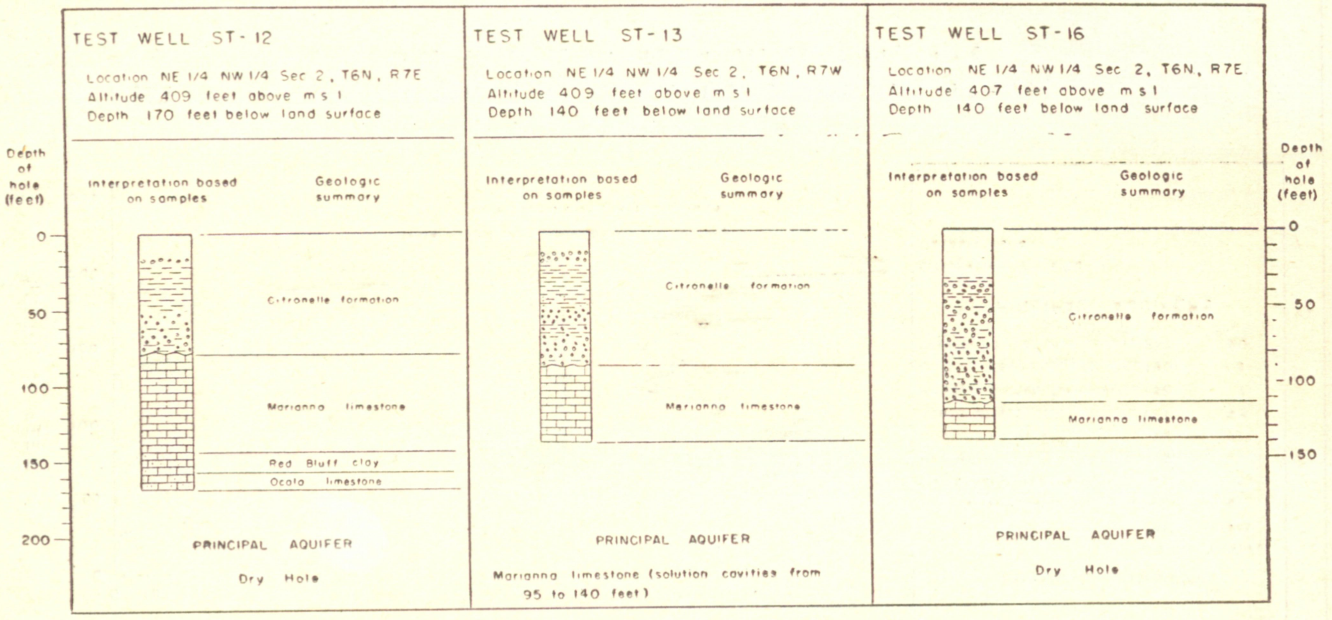

TEST WELL ST-12
Location NE 1/4 NW 1/4 Sec 2, T6N, R7E
Altitude 409 feet above m s l
Depth 170 feet below land surface
Interpretation based on samples
Geologic summary
Citronelle formation
Marianna limestone
Red Bluff clay
Ocala limestone
PRINCIPAL AQUIFER
Dry Hole
TEST WELL ST-13
Location NE 1/4 NW 1/4 Sec 2, T6N, R7W
Altitude 409 feet above m s l
Depth 140 feet below land surface
Interpretation based on samples
Geologic summary
Citronelle formation
Marianna limestone
PRINCIPAL AQUIFER
Marianna limestone (solution cavities from 95 to 140 feet)
TEST WELL ST-16
Location NE 1/4 NW 1/4 Sec 2, T6N, R7E
Altitude 407 feet above m s l
Depth 140 feet below land surface
Interpretation based on samples
Geologic summary
Citronelle formation
Marianna limestone
PRINCIPAL AQUIFER
Dry Hole
Depth of hole (feet)
0
50
100
150
200

Figure 21 – Lithologic logs of test wells ST-12, -13, -16, showing principal aquifers

GEOLOGIC FORMATIONS AND THEIR WATER-BEARING PROPERTIES

GENERAL STRATIGRAPHY AND STRUCTURE

Monroeville lies on the outcrop of formations of Tertiary age in the Coastal Plain physiographic province. Formations of late Eocene, Oligocene, Miocene, Pliocene, Pleistocene, and Recent age crop out near Monroeville. Formations of early Eocene and late Paleocene age, which crop out in northern Monroe County, were penetrated in the deep test well (DT-1) southwest of the city.

The formations of Eocene age exposed in the report area are divided into the Claiborne and Jackson groups. The Claiborne group includes the Tallahatta and Lisbon formations and the Gosport sand; the Jackson group includes the Moodys Branch formation, the Yazoo clay, a name extended into this area for the first time, and the Ocala limestone. Formations of Oligocene age are the Red Bluff clay (limestone facies) and the Vicksburg group. The Vicksburg group is composed of the Marianna limestone and the Byram formation, which includes the Glendon limestone, the marl, and the Bucatunna clay members. Sediments of Miocene age reported and mapped by MacNeil (1946) have been included with the Citronelle formation of Pliocene age in this report. The Citronelle formation rests on the eroded surface of the older rocks.

These formations strike regionally northwest, and dip southwest about 30 to 50 feet per mile. The structure is normal except for small faults which probably have less than 40 feet of displacement. The fence diagram (see pl. 4) illustrates the general structure and stratigraphy and shows a strike section trending northwest and a dip section trending southwest.

PALEOCENE SERIES

Rocks of Paleocene age crop out about 25 miles north of Monroeville in the vicinity of Camden, Wilcox County, and dip southward at the rate of 30 to 50 feet per mile. The upper part of these beds consists of brown clay with fine-grained glauconite and probably represents the Naheola formation. They were penetrated at a depth of 1,213 feet in the deep test well, DT-1, drilled at Monroeville (see pl. 3).

EOCENE SERIES

Wilcox Group

The Wilcox group, of early Eocene age, consists of the Nanafalia formation, the Tuscahoma sand, and the Hatchetigbee formation. These formations crop out 11 to 20 miles north of Monroeville in northern Monroe and southern Wilcox Counties, and dip southward about 30 to 50 feet per mile. The entire thickness of the Wilcox group was penetrated between depths of 422 and 1,213 feet in well DT-1 near Monroeville, and drill cuttings from the well are the basis of geologic data on the Wilcox included in this report.

Nanafalia Formation and Tuscahoma Sand Undifferentiated

General features.—The Nanafalia formation and Tuscahoma sand were not differentiated in well DT-1 because of their similar lithologies near the contact. This unit includes shale, sand, limestone, and a basal sand bed in the Nanafalia formation.

Thickness and lithology.—The Nanafalia formation and Tuscahoma sand undifferentiated may be divided into two principal parts. The upper part, between 625 and 1,167 feet in the deep test well (DT-1) is composed of clear to milky, very fine- to medium-grained glauconitic micaceous fossiliferous sand interbedded with blue-gray to brown micaceous silty shale and white glauconitic limestone containing fine to medium sand grains. The lower part of this interval may be the Salt Mountain limestone, a downdip facies of the Nanafalia formation. The basal sand of the Nanafalia formation, penetrated from 1,167 to 1,213 feet, consists of clear to milky quartz sand, predominantly medium-grained, subangular, and glauconitic.

Water supply.—The basal sand of the Nanafalia formation is the deepest tested fresh-water aquifer in the report area. During the drilling of well DT-1, a drill stem test of this aquifer showed it to have a water level of 47 feet below land surface on November 20, 1951. This aquifer was tested by pumping by air for 2 hours at the rate of 27.5 gpm with a drawdown of 9.6 feet.

The upper part of the Nanafalia formation and the lower part of the Tuscahoma sand were tested together in deep test well DT-1. This aquifer had a water level of 29.2 feet on November 12, 1951. It was pumped by air for 36 hours at the rate of 15 gpm with a drawdown of 28.5 feet.

Data from test drilling indicated that the Nanafalia formation and Tuscahoma sand offer the best potential for the development of relatively large ground-water supplies in the Monroeville area. Two municipal wells at Monroeville, about two miles northeast of and at an altitude about 200 feet higher than deep test well DT-1, have been developed in these sands. One of these wells was drilled to a depth of 1,410 feet and screened opposite sand beds from 1,252 to 1,292 and 1,354 to 1,394 feet. This well is reported to have a water level of about 260 feet below land surface, and had a drawdown of 145 feet after pumping 900 gpm for 8 hours. The other well, drilled to a depth of 1,216 feet, is reported to have a water level of 272 feet below land surface, and had a drawdown of 119 feet after pumping 800 gpm for 7½ hours on July 15, 1955.

Quality of water.—A sample of water for chemical analysis was obtained from the basal sand of the Nanafalia formation during the drilling of the deep test well DT-1 (see table 2).

This analysis indicates that the water is high in bicarbonate and dissolved solids. It is a soft, alkaline water which will not be corrosive, and can be used for most water requirements.

A sample of water from the upper part of the Nanafalia formation and Tuscahoma sand undifferentiated is low in all constituents except bicarbonate, fluoride, and dissolved solids. This water is soft and noncorrosive. It is interesting to note that the water contains natural fluoride in an amount slightly in excess of that commonly introduced in public water supplies to inhibit tooth decay.

Hatchetigbee Formation

General features.—The Hatchetigbee formation consists of sand and clay and includes a basal marl member, the Bashi, a persistent and easily recognized unit in west and central Alabama which is frequently used as a key bed for surface and subsurface geologic correlations.

Thickness and lithology.—The Hatchetigbee formation, including the Bashi marl member, was penetrated between 422 and 625 feet in well DT-1. The formation consists of light-gray to brown sand and silt containing some glauconite and mica. The Bashi marl member is calcareous sandy marl with abundant coarse-grained glauconite and fossils.

Water supply.—Although the Hatchetigbee formation contains thin sand beds, it has not been developed as a source of water supply in the Monroeville area. However, sands in the upper part of the formation and the Bashi marl member are good aquifers in other parts of the State (Toulmin, et al., 1951, p. 92). Adequate water supplies could be developed from these beds in the area to supply domestic or farm requirements.

Claiborne Group

The Claiborne group, named for the community of Claiborne on the Alabama River in western Monroe County, Ala., (Toulmin, et al., 1951, p. 268), consists of marine clastic and calcareous deposits. In the report area the Claiborne includes the Tallahatta formation and the Gosport sand and Lisbon formation undifferentiated (see pl. 1). The sand beds in the Claiborne group are important across the State as a source of water supply for many industrial, municipal and agricultural wells. In well DT-1 sediments of the Claiborne group were penetrated between depths of 80 and 422 feet (see pl. 3).

Tallahatta Formation

General features.—The Tallahatta formation was named by Dall (1898, p. 344) from the Tallahatta hills in north-central Choctaw County, Ala. It consists of resistant claystone and forms a north-facing escarpment across the northern part of Monroe County. The Tallahatta crops out northeast of Monroeville in an irregular area along Walker Branch and Brushy and Limestone Creeks. This outcrop is an inlier separated from the main exposures of the formation in northern Monroe County. Good exposures of claystone occur in a road cut about a quarter of a mile southeast of Peterman (see pl. 5).

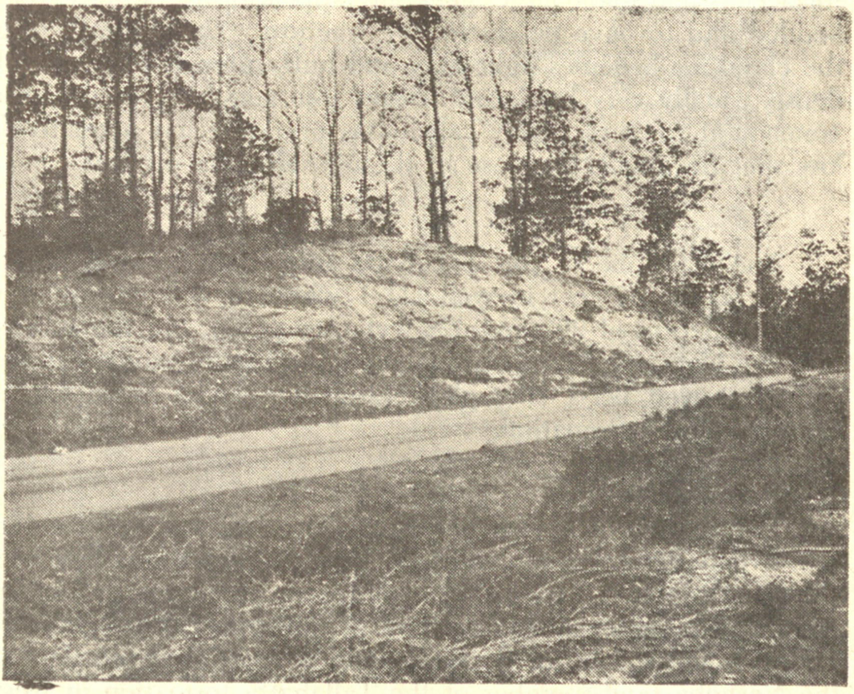


Plate 5.–Exposure of the Tallahatta formation in a road cut about a quarter of a mile southeast of Peterman, Ala., on the road to Burnt Corn in the SE¼SW¼ sec. 10, T. 7 N., R. 8 E.

Thickness and lithology.—The Tallahatta formation in surface exposures consists in general of about 100 feet of claystone predominantly tan to gray, medium-bedded weathering rubbly with a few thin indurated quartzitic layers. It is best exposed in Monroe County in a road cut 17 miles north of Monroeville on State Highway 11 where exposures include soft clay and claystone when fresh, and hard claystone or buhrstone when weathered and dry. The fresh claystone is blue to blue-green, micaceous and glauconitic, generally appearing to be massively-bedded and to have no distinctive fracture. Upon weathering, the claystone becomes light gray and buff, often is iron stained, dense, usually very hard, and breaks into angular pieces with a conchoidal fracture. The Tallahatta formation has a relatively low specific gravity because of its high alumina content.

The claystone of the Tallahatta formation thickens downdip to about 217 feet in well DT-1 where it was encountered between depths of 205 and 422 feet (see pl. 3). In the subsurface the claystone becomes glauconitic and more sandy. In the deep test well DT-1 silty glauconitic sand layers were logged throughout the formation.

Stratigraphy and paleontology.—The Tallahatta formation is overlain disconformably by the Lisbon formation; however, the exact contact is obscure in some places because a sand in the Lisbon rests on a glauconitic sand at the top of the Tallahatta. The glauconitic sand of the Tallahatta is probably equivalent to the Neshoba sand member of the Tallahatta formation in western Alabama and eastern Mississippi. For mapping purposes the contact was chosen at the top of the claystone. The stratigraphic error is small as the sand at the top of the Tallahatta, where present, is less than 5 feet thick. The best exposure of the contact in the area of this study is in a section measured in a creek bed in the SE¼NE¼ sec. 20, T. 7 N., R. 8 E. (see fig. 22).

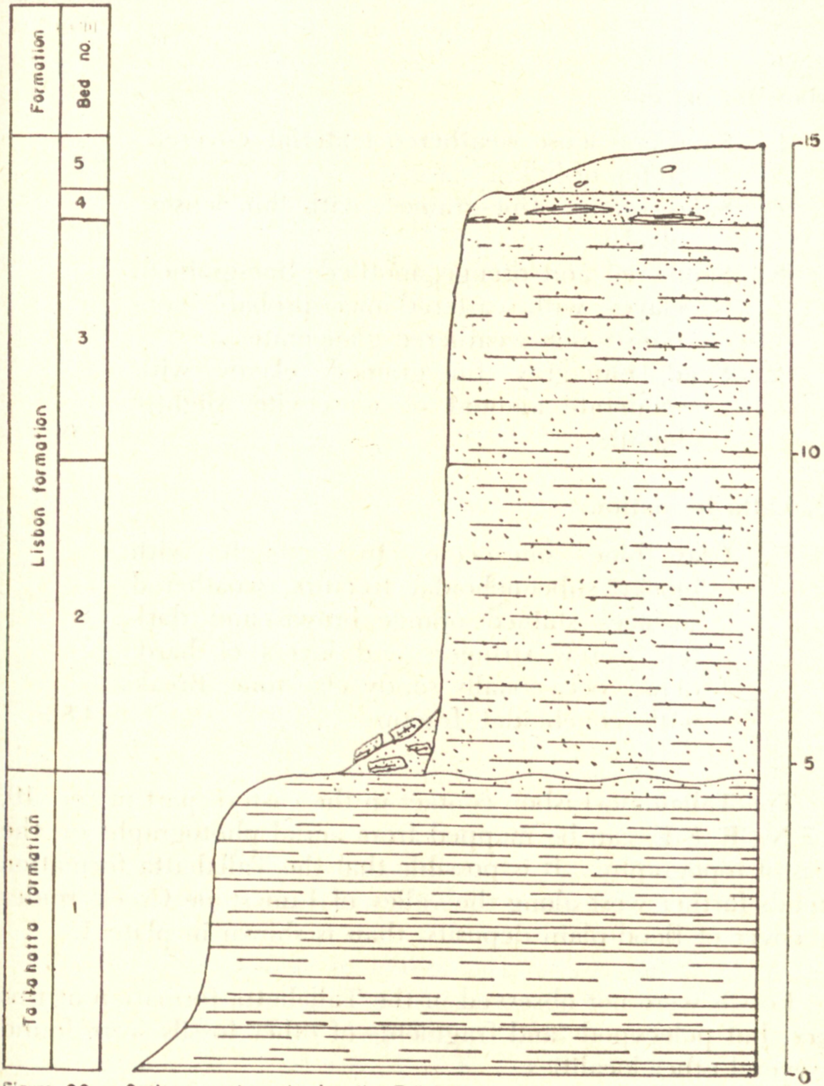

Formation
Bed no.
Lisbon formation
Tallahatta formation
5
4
3
2
1
15
10
5
0
Thickness, in feet

Figure 22.-- Geologic section showing the Tallahatta-Lisbon contact in the SE 1/4 NE 1/4 sec. 20, T. 7 N., R. 8 E. (location 1 on pl. 1).

Geologic section in the SE¼NE¼ sec. 20, T. 7, N., R. 8 E.
(Location 1 on pl. 1)

	Thickness Feet
Lisbon formation:	
5. Sand and loose weathered material, covered to top of hill	5+
4. Sand, orange, fine-grained, with thin lenses of clay	0.5
3. Sand, red and orange, mottled, fine-grained, clayey, with scattered mica; probably contains much weathered glauconite	3.9
2. Sand, blue-gray, fine-grained, clayey with moderate amount of muscovite, slightly lignitic	5.0
Tallahatta formation:	
1 Clay, blue, micaceous, firm, tough, with blocky subconchoidal fracture, weathered surfaces stained orange brown and dark tan, a few stringers and layers of hard, dense, occasionally sandy claystone. Breaks with conchoidal fracture	4.8+

The Tallahatta-Lisbon contact in the eastern part of sec. 19, T. 7 N., R. 8 E. can be mapped from aerial photographs on the basis of topography. It is possible that the Tallahatta formation extends farther west along the valley of Limestone Creek, under the cover of flood-plain deposits, than is shown in plate 1.

Fossils were not observed in the Tallahatta formation at this place, but pelecypods and fragments of other fossils were found at several other localities.

Water Supply.—Wells 50 and 51 in this report (see table 1) probably develop water from sand beds in the lower part of the Tallahatta formation, and well 49 draws water from either a sand bed in the Tallahatta or from sand and gravel in the alluvial fill of Limestone Creek.

Lisbon Formation and Gosport Sand

General Features.—The Lisbon formation, named from Lisbon Landing, and the Gosport sand, named from Gosport Bluff on the Alabama River (Cooke, 1926, p. 270-272) in Clarke County, Ala., where the type sections are exposed, were mapped together as a unit for this report.

The Lisbon formation crops out north of Monroeville in an irregular band 2 to 6 miles wide trending east-west across Monroe County (see pl. 1). The Gosport sand overlies the Lisbon formation, with which it is mapped, and these formations crop out in the northern and eastern parts of the report area, mainly in the valley of Limestone Creek. Flood-plain deposits obscure much of the outcrop area of these formations, and fresh exposures of the Lisbon formation and Gosport sand are found only along hill slopes and in gullies tributary to Limestone Creek.

Thickness and Lithology.—Although 109 feet of the Lisbon formation was penetrated in the deep test well DT-1 between depths of 96 and 205 feet, complete sections of the formation are not exposed in the vicinity of Monroeville. The upper part of the Lisbon formation in the vicinity of Monroeville consists of tan, fine- to medium-grained angular to subangular sand which is sparsely glauconitic and contains numerous *Ostrea sellaeformis* (Conrad). This sand was about 46 feet thick in the deep test well, but does not appear to be uniform in thickness or lithology. The upper sandy part of the Lisbon thins and becomes more clayey or silty north and east of DT-1. The lower 50 to 60 feet of the Lisbon in the deep test well consists of silty and fine-grained sand with glauconite and scattered muscovite.

Beds in the Lisbon formation are weathered in exposures along Limestone Creek. A good section of the weathered sand is exposed in the road cut along State Highway 11 in the SW¼ sec. 2 and the SE¼ sec. 22, T. 7 N., R. 7 E. (see fig. 27).

The upper part of the Lisbon formation in the NE¼SE¼ sec. 21, T. 7 N., R. 7 E. (see fig. 24) contains a hard ledge of limestone with lenses containing *O. sellaeformis*. Below the limestone ledge is a bed of sparingly glauconitic marl 3 to 5 feet thick, and below that is sand. A lower part of this sand is exposed about

50 yards northwest of this section and contains abundant *O. sellaeformis.* Another good exposure of the upper sandy part of the Lisbon is found in the SE¼SW¼ sec 28, T. 7 N., R. 8 E., where a tan sand containing abundant *O. sellaeformis* and lenses of white limestone lies beneath weathered Gosport sand.

The Gosport sand was measured at the surface, and complete thicknesses of it were penetrated in several of the shallow test wells (see figs. 8, 10, 12, 14, 17, and 20) and in the deep test well (see pl. 3). The Gosport sand is 5 to 11 feet thick and averages about 8 feet. The upper part consists of green, glauconitic sand containing abundant fossils. The lower half of the Gosport consists of light-brown thin-bedded shale containing lignite and leaf prints.

Weathered Gosport sand is exposed in a section measured in a gully on the west side of Highway 47 about 3 miles north of Monroeville, in the SW corner, sec. 20, T. 7 N., R. 8 E. (see fig. 23). At Claiborne Bluff, about 11 miles northwest of Monroeville on the Alabama River, approximately 11 feet of interbedded lignitic shales and glauconitic sand overlie about 5 feet of the very fossiliferous glauconitic sand (Stenzel, 1952, p. 58). The Gosport section at Claiborne Bluff is one of the best exposures of this formation in the Coastal Plain.

Stratigraphy and Paleontology.—The Lisbon formation overlies the Tallahatta formation disconformably, and the contact between these formations is in a sand bed of which the lower part is sand of the Tallahatta relatively free of glauconite, and the upper part is glauconitic sand of the Lisbon (see fig. 22). The upper part of the Lisbon formation found in several exposures in the report area contains an abundance of *O. sellaeformis,* an oyster whose shells have a wide range of sizes and shapes. This fossil is generally more abundant in the sandy phases than in the marly phase of the Lisbon in this area.

The Gosport sand overlies the Lisbon formation disconformably. The contact can be seen easily, as the tan medium-grained generally sparsely glauconitic sand or the bluish sandy marl at the top of the Lisbon contrasts with the green coarse-grained glauconitic very fossiliferous sand of the Gosport. In weathered exposures the tan or almost white medium-grained sand of the

Lisbon is readily distinguished from the overlying red coarse-grained sand of the Gosport.

The Gosport sand is one of the most fossiliferous formations in the Gulf Coastal Plain and contains *Crepidula lirata* Conrad, *Venericardia alticostata* (Conrad), several species of *Glycymeris* and *Turritella*, and other fossils.

The following fossils, collected from an exposure of the Gosport sand in the NE¼NW¼ sec. 30, T. 7 N., R. 8 E., were identified by F. S. MacNeil of the U. S. Geological Survey (see pl. 7):

Glycymeris staminea Conrad
Cardita rotunda (Lea)
Callocardia lisbonensis (Harris)
Corbula murchinsoni Lea
Crepidula lirata Conrad
Mesalia claibornensis Harris

Water supply.—Sand beds in the Gosport sand and upper part of the Lisbon formation form an aquifer which is developed as a source of water supply in the Monroeville area. Wells C-3, C-4, 21 (?), 77, 78, 82, and 86 (see table 1) develop water from this aquifer. During the drilling of well DT-1, a drill-stem test of the Gosport sand and Lisbon formation showed it to have a water level of 18.8 feet below the land surface. The test well was pumped at the rate of 12 gpm, and the drawdown was 5.8 feet indicating a specific capacity of 2.1 gpm per foot of drawdown. City of Monroeville supply wells C-3 and C-4 are developed in this aquifer, and in 1952 had yields of 75 and 140 gpm, respectively.

Quality of water.—Water from the Gosport sand and Lisbon formation is generally of good quality. Although only partial analyses are available, there is sufficient evidence to indicate that the water from this source is uniform in composition. (See table 2.) Water from wells in this aquifer ranged from 0.09 to 1.3 parts per million (ppm) in iron, 57 to 178 ppm in bicarbonate, 1.0 to 9.2 ppm in sulfate, 0.2 to 5.4 ppm in nitrate, 3.0 to 7.1 ppm in chloride, and 0.1 to 0.2 ppm in fluoride content, and from 61 to 147 ppm in hardness. A water sample from the Gosport sand and Lisbon formation in deep test well DT-1, contained 195 ppm of dissolved solids and the sample in well C-4, 175 ppm of dissolved solids. The pH of water samples from the Gosport sand and Lisbon formation ranged from 7.4 to 7.9. The water is therefore slightly alkaline.

Jackson Group

The Jackson group, according to Cooke (1926, p. 274), is named for exposures at Jackson, Miss. In the Monroeville area the group is composed of fossiliferous to nonfossiliferous marine limestone, marl, clay, and sand. The Jackson group in central Monroe County comprises the Ocala limestone, Yazoo clay (restricted), and Moodys Branch formation.

Moodys Branch Formation and Yazoo Clay (restricted)

General features.—The Moodys Branch formation was named the Moodys Branch marl by Lowe (1915, p. 75) for exposures along Moodys Branch in Jackson, Miss.; the Yazoo formation was also named by Lowe (1915, p. 75) for exposures at Yazoo City. The term Yazoo clay (restricted) will be used in this report and the Moodys Branch formation and Yazoo clay are shown together as a unit on the geologic map. (see pl. 1).

The Moodys Branch formation lies below the Yazoo clay. The contact between the formations is often obscured by weathering Exposures of the Yazoo clay and Moodys Branch formation are found in gullies on all sides of Monroeville except the south. The best exposures of the Moodys Branch are north and northwest of town. The width of the outcrop of the two formations ranges from a few hundred feet to more than a mile, depending on the topography and the distribution of the Citronelle formation which overlaps the Yazoo in many areas.

Where it lies at the surface the Yazoo clay has a gently rolling topography, and where streams cut into it broad, flat valleys and swamps or marshes are formed. The Moodys Branch formation is too thin to have a pronounced topographic expression except where it is indurated and forms slight topographic benches.

Thickness and lithology.—The Moodys Branch formation ranges in thickness from 3 to 16 feet and averages about 7 feet. In electric logs of drill holes penetrating this formation two prominent low-resistivity curves mark the top and bottom of the Moodys Branch.

The Moodys Branch formation consists predominantly of a blue-green to buff, glauconitic, fine to medium, sandy fossiliferous marl (see fig. 28) and a pale-orange glauconitic sandy hard fossiliferous limestone containing scattered subrounded quartz pebbles (see fig. 25).

A weathered section of the Moodys Branch is exposed in a deep gully on the west side of Highway 47 about 3 miles north of Monroeville (see fig. 23).

Geologic section about 3 miles north of Monroeville on Highway 47 in SW cor. sec. 20, T. 7 N., R. 8 E. (Location 2 on pl. 1)

	Thickness Feet
Yazoo clay (restricted):	
9. Clay, weathered; sand and gravel float from the Citronelle formation	15-20
8. Clay, tan, [illegible] sectile, blocky, with streaks of glauconitic sand	3.5
Moodys Branch formation:	
7. Clay or marl, tan, thin-bedded, with layers and lenses of glauconitic sand, dark-green or black, and with worm borings at top	4.2
6. Limestone or marl, tan, glauconitic, clayey, fossiliferous; contains coarse-grained phosphatic pellets	2.5
5. Sand, blue-green, coarse, glauconitic, with light-buff clay streaks	0.6-0.8
4. Limestone, weathered to yellow or orange, and containing scattered very coarse glauconite and quartz pebbles	0.6-1.0

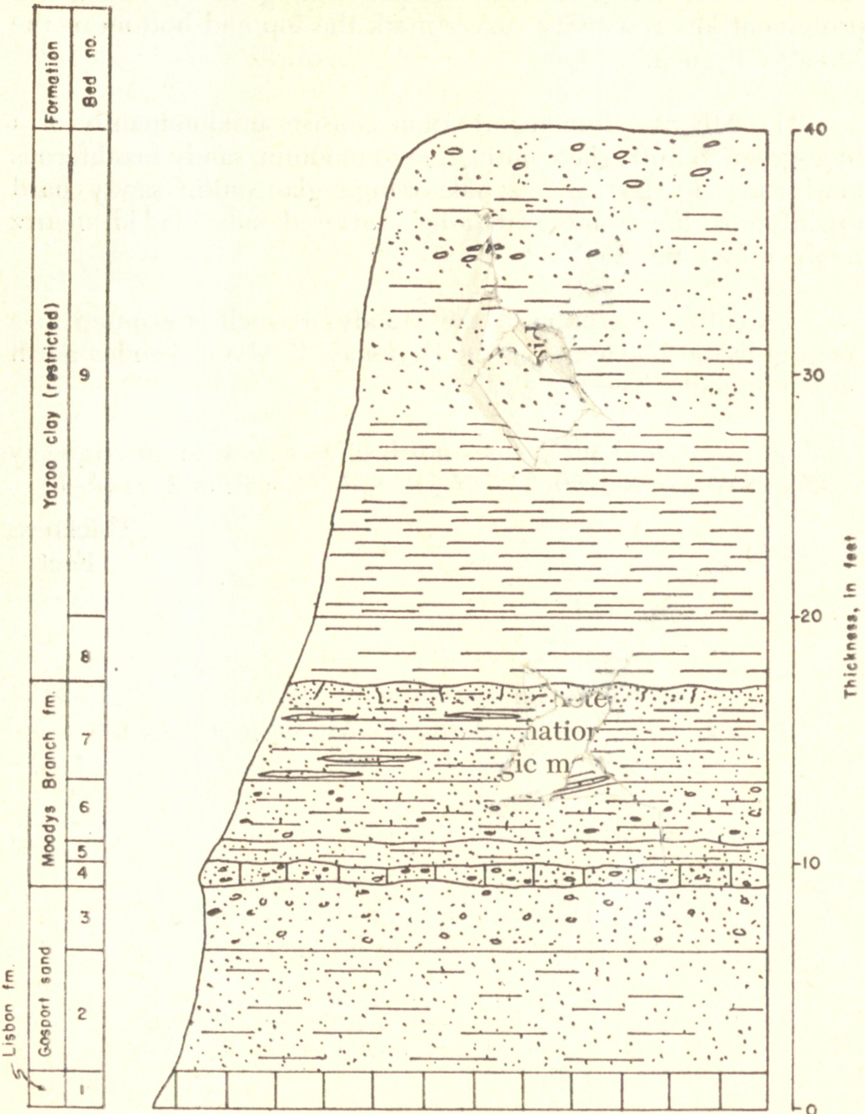

Formation
Bed no.
Yazoo clay (restricted)
Moodys Branch fm.
Gosport sand
Lisbon fm.
9
8
7
6
5
4
3
2
1
40
30
20
10
0
Thickness, in feet

Figure 23.-- Section about 3 miles north of Monroeville on Highway 47 in the SW corner, sec. 20, T. 7 N., R. 8 E. (location 2 on pl. 1).

	Thickness Feet
Gosport sand:	
3. Sand, orange, medium- to very coarse-grained and pebbly; contains clayey fossil remains	2.6
2. Sand, white with orange streaks, clayey; contains weathered fossil remains	4.9
Lisbon formation:	
1. Limestone, chalky white, soft to hard; contains scattered *Ostrea sellaeformis* Conrad	2+

Even though fossils are poorly preserved in the beds assigned to the Gosport, the lithology suggests that bed 3 may be the bed containing *Chlamys deshayesii* which Stenzel (1952, p. 58) names the Dellet sand and assigned to the basal Jackson.

A section showing the contact between the Yazoo clay (restricted) and Moodys Branch formation is exposed about 3 miles northwest of Monroeville in the NE¼SE¼ sec. 21, T. 7 N., R. 7 E. (see fig. 24).

Geologic section in the NE¼SE¼ sec. 21, T. 7 N., R. 7 E.

(Location 3 on pl. 1)

	Thickness Feet
Yazoo clay (restricted):	
7. Clayey marl with cover of Citronelle float	5+
Moodys Branch formation:	
6. Marl, buff, massive, clayey; flakes when hit; contains fine- to medium-grained glauconite, sand, and clay; becomes harder in lower part	5
5. Sand, iron-stained, medium- to coarse-grained, slightly clayey, fossiliferous with *Periarchus lyelli* Conrad. Within the sand are nodules and masses of white limestone with coarse brown phosphatic (?) sand	3
Gosport sand:	
4. Covered interval	6

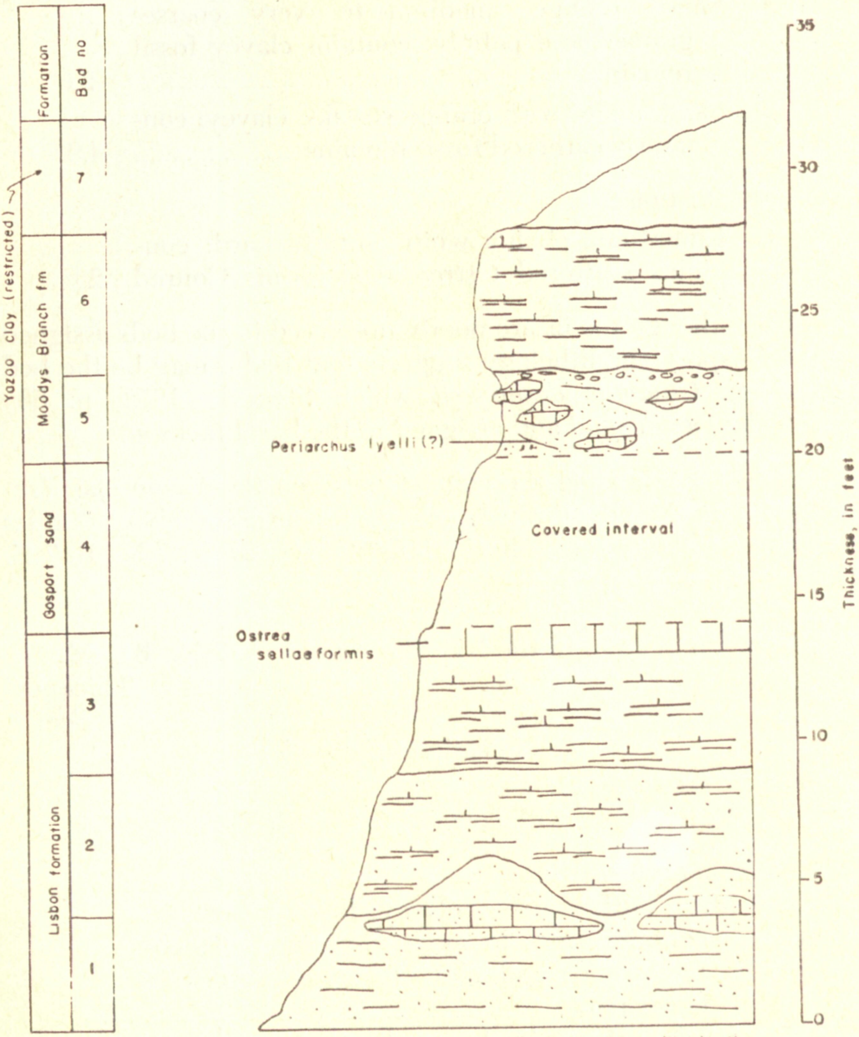

Formation
Bed no
Yazoo clay (restricted) ?
7
Moodys Branch fm
6
5
Gosport sand
4
Lisbon formation
3
2
1
Periarchus lyelli (?)
Covered interval
Ostrea sellaeformis
35
30
25
20
15
10
5
0
Thickness, in feet

Figure 24 -- Geologic section about 3 miles northwest of Monroeville in the NE 1/4 SE 1/4 sec. 21, T 7 N, R 7 E (location 3 on pl 1).

	Thickness Feet
Lisbon formation:	
3. Clay or marl, pale-green, containing abundant *Ostrea sellaeformis* Conrad in streaks; 1-foot bed of white hard dense limestone at the top	4
2. Marl, light-olive-green, clayey, tough, slightly glauconitic, with scattered coarse grains	3.5-5.0
1. Sand, brown, and green coarse glauconite, fine- to medium-grained, slightly clayey with hard coquina-like glauconitic limestone streak at or near the top	2+

The lower 3 feet of the Moodys Branch (bed 5) composed of iron-stained coarse-grained sand containing fragments of *Periarchus* sp., may be equivalent to the Dellet sand described by Stenzel (1952, p. 58) at Claiborne Bluff.

The Yazoo clay (restricted) is about 60 feet thick. Shallow test wells (see figs. 8, 9, 10, 12, 14, 17, and 20) penetrated the complete thickness of this formation, and one complete surface section of Yazoo was measured (see fig. 28).

The Yazoo clay is composed predominantly of blue-green blocky calcareous and noncalcareous clay which is locally fossiliferous and contains limestone, marl, and clay beds with lenses and tubes of fine micaceous sand. Two divisions of the Yazoo clay are indicated from electric logs and drill cuttings of the shallow test wells. The upper half of the formation is a sandy calcareous silty clay; the lower half is a more sandy marl. The upper half is more clayey, sandy, and less calcareous than the lower section, and is exposed in the NW¼NE¼ sec. 27, T. 7 N., R. 7 E. (see fig. 25). The upper 9 feet of the section is interbedded clay and laminae of fine sand; the lower 10 feet (bed 1) is more calcareous, blocky sandy clay similar to bed 8 in figure 26.

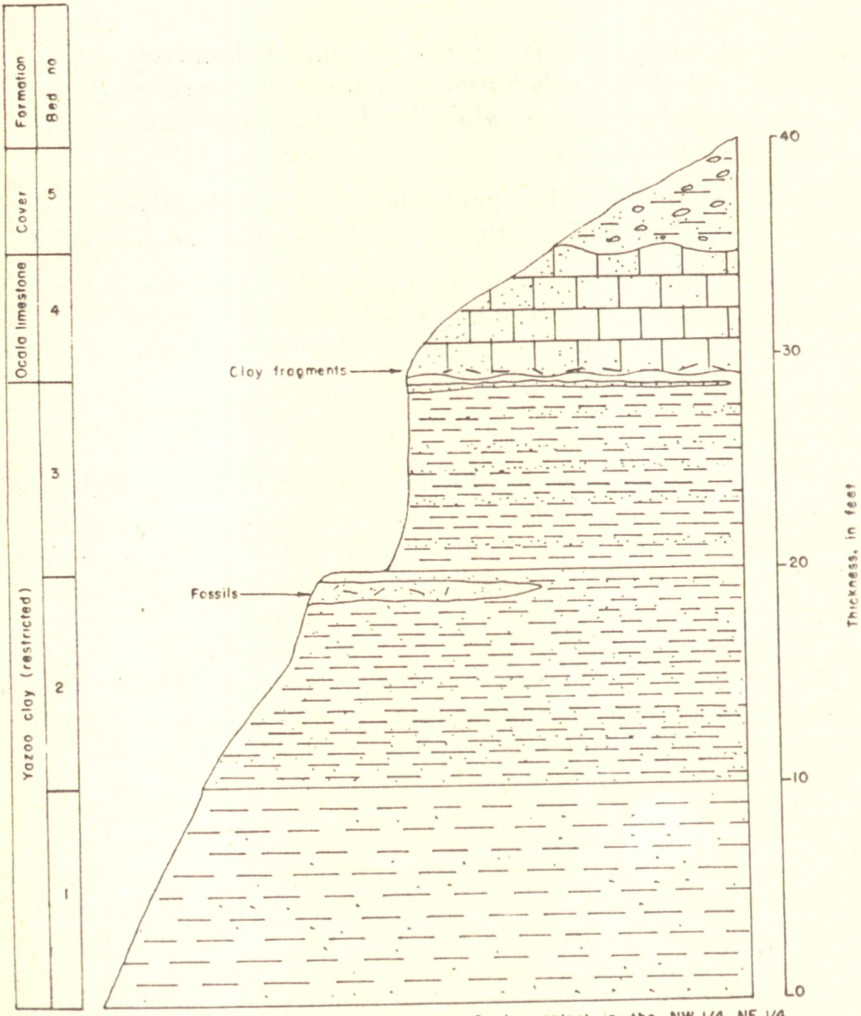

Formation
Bed no
Cover
5
Ocala limestone
4
Yazoo clay (restricted)
3
2
1
Clay fragments
Fossils
40
30
20
10
0
Thickness, in feet

Figure 25.-- Geologic section showing the Yazoo-Ocala contact in the NW 1/4 NE 1/4 sec. 27, T 7 N, R 7 E (location 4 on pl. 1)

Geologic section in the NW¼NE¼ sec. 27, T. 7 N., R. 7 E.

(Location 4 on pl. 1)

	Thickness Feet
5. Gravel, sand, and clay float from the Citronelle formation	5
Ocala limestone:	
4. Limestone, buff, and abundant quartz sand and medium- to coarse-grained glauconite, very sparsely fossiliferous. Basal 6 inches contains fragments of clay from below	6
Yazoo clay (restricted):	
3. Clay, blue-green when fresh, dark-brown to black when weathered, blocky, breaks with subconchoidal fracture, in layers 1½ to 4 inches thick separated by laminae of very fine sand. Lenses of sand near top 2 to 3 inches thick	9
2. Clay, blue-green when fresh, tan to brown when weathered, more sandy than bed 1 but less massive and much more fossiliferous with pelecypods, gastropods, and fish or shark scales	10
1. Clay, blue-green, massive, micaceous, sandy, fine, sparsely fossiliferous	10

The lower section of the Yazoo clay (see fig. 26) in most outcrops appears to be a soft limestone, and is exposed in NW¼NW¼ sec. 28, T. 7 N., R. 7 E.

Geologic section in the NW¼NW¼ sec. 28, T. 7 N., R. 7 E. (Location 5 on pl. 1)

	Thickness Feet
Yazoo clay (restricted):	
9. Colluvium and rubble to the top of hill	5+
8. Clay, weathered brown and tan, blocky, massive, micaceous, and fossiliferous	4
7. Clay, weathered brown and tan, micaceous, and sandy	5

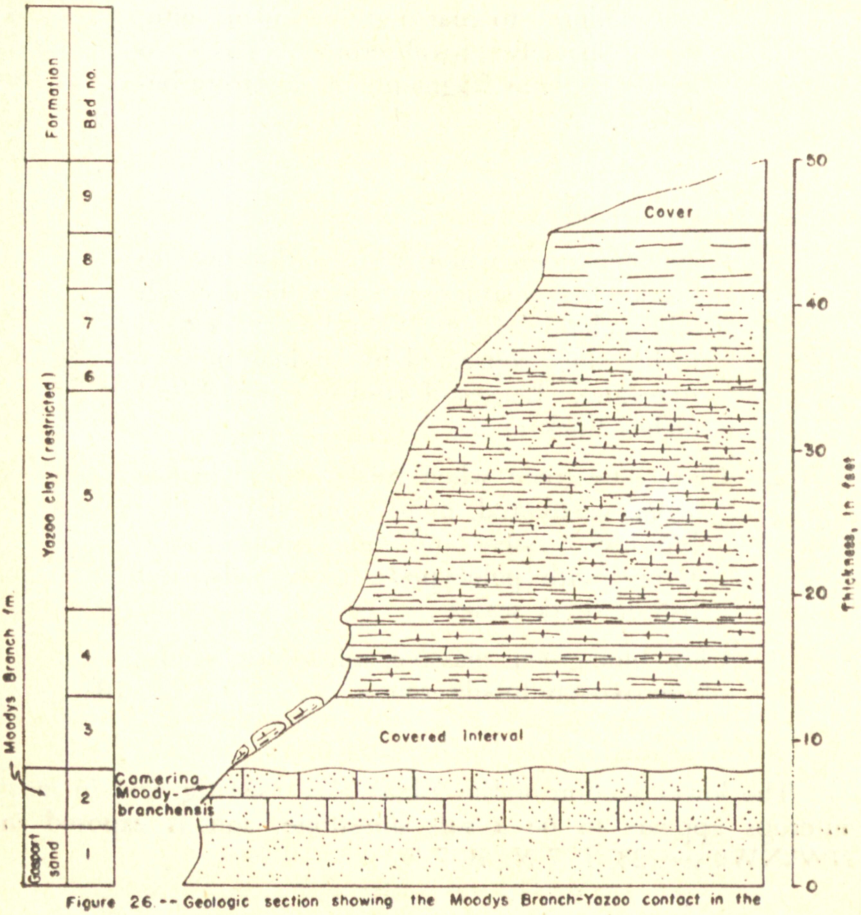

Formation
Bed no.
Yazoo clay (restricted)
Moodys Branch fm.
Gosport sand
9
8
7
6
5
4
3
2
1
Cover
Covered interval
Camerina Moody-branchensis
50
40
30
20
10
0
Thickness, in feet

Figure 26.--Geologic section showing the Moodys Branch-Yazoo contact in the NW 1/4 NW 1/4 sec. 28, T. 7 N., R. 7 E. (location 5 on pl. 1).

	Thickness Feet
Yazoo clay (restricted)—continued	
6. Marl, tan, sandy, micaceous, hard	2
5. Marl, tan, clayey and silty, micaceous, sparsely glauconitic; contains thin hard layers; breaks with semiconchoidal fracture	15±
4. Marl, tan, sandy, and very fine sand, micaceous, sparsely glauconitic; indurated beds 1 foot thick at top and in middle	6
3. Covered; loose blocks of Yazoo spread over surface, possibly Moodys Branch	5
Moodys Branch formation:	
2. Limestone, pale-orange, sandy, and scattered coarse- and medium-grained glauconitic fossiliferous sand, with *Camerina moodybranchensis* Gravell and Hanna	4±
Gosport sand:	
1. Sand. medium to coarse, glauconitic, fossiliferous	4+

In a weathered section of Yazoo clay about 2 miles north of Monroeville, on Highway 11, blue-green blocky Yazoo clay is overlain by sand and gravel of the Citronelle formation (see fig. 27).

Geologic section along Highway 11 about 2 miles north of Monroeville in the SW¼ sec. 23 and SE¼ sec. 22, T. 7 N. R. 7 E. (Location 6 on pl. 1)

	Thickness Feet
Citronelle formation:	
8. Sand and gravel, red, clayey, exposed in drainage ditch on east side of road	20+
Yazoo clay (restricted):	
7. Clay, green, blocky, exposed in drainage ditch on east side of road. Lower 23 ± feet covered	30

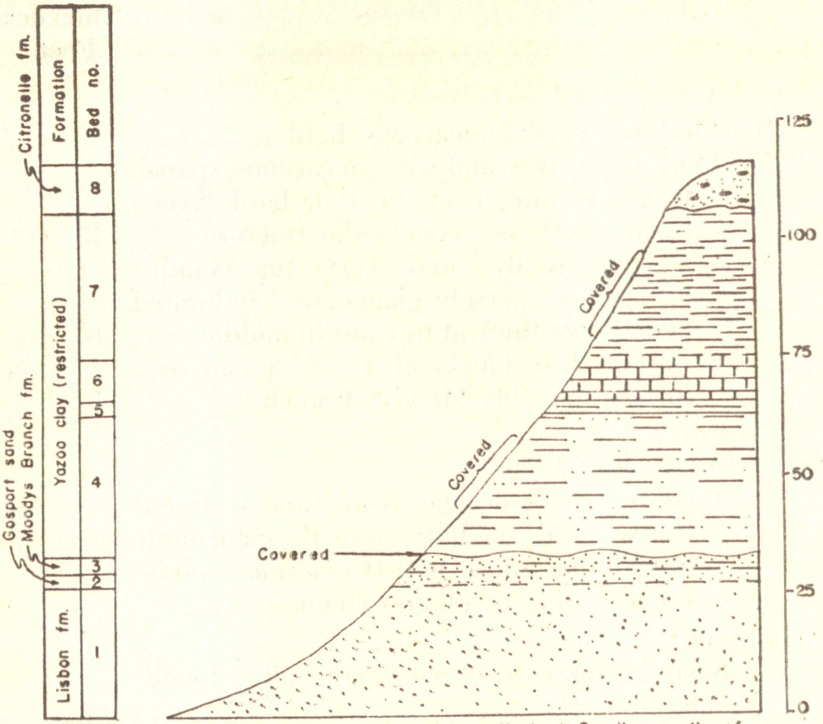

Citronelle fm.
Formation
Bed no.
8
7
6
5
4
3
2
1
Gosport sand
Moodys Branch fm.
Yazoo clay (restricted)
Lisbon fm.
Covered
Covered
Covered
125
100
75
50
25
0
Thickness, in feet

Figure 27.--Geologic section along State Highway 11 about 2 miles north of Monroeville in the SW 1/4 sec. 23 and SE 1/4 sec. 22, T. 7 N., R. 7 E., (location 6 on pl. 1).

6. Limestone, white, tough, flaky, sparsely glauconitic 9

5. Clay, greenish-tan, blocky, plastic, jointed, possibly weathered calcareous material 3

4. Clay, light-tan, and medium-grained angular to subangular quartz sand. Middle part of bed covered 26

Moodys Branch formation:

3. Sand, olive-drab, medium- to coarse-grained; very glauconitic clay streaks; highly weathered 3

Gosport sand:

2. Sand, pale-green, medium- to coarse-grained, angular to subangular, glauconitic, siliceous; fossil fragments 3

	Thickness Feet
Lisbon formation:	
1. Sand, tan, locally stained red from Citronelle wash, clear quartz, medium-grained, angular, highly weathered	27+

An 11 foot bed of clay, yellow, sectile, with tubes and lenses of fine sand is exposed below the Ocala limestone in a composite section, exposing formations from the Lisbon formation to the Red Bluff clay, in the NW¼ sec. 30, T. 7 N., R. 8 E. (see fig. 28). Other exposures of this clay are in the S½ sec. 30, but east and west of this area blue-green fossiliferous clay without tubes and lenses of sand underlies the Ocala.

Composite section from the Lisbon formation to the Red Bluff clay in the NW¼ sec. 30, T. 7 N., R. 8 E.
(Location 7 on pl. 1)

	Thickness Feet
Red Bluff clay (limestone facies):	
11. Limestone, buff to light-tan, soft, finely glauconitic, containing phosphatic pebbles, worm borings, and replacements of fossils	10+
Ocala limestone:	
10. Limestone, buff, iron-stained, indurated, nodular, containing *Chlamys centrotus* Dall and other fossils, with a 2- to 3-foot bed of hard sandy, coarsely glauconitic limestone at the base	38±
Offset to gully 200 yards to the east.	
Yazoo clay (restricted):	
9. Clay, yellow, sectile, blocky, with tubes and lenses of fine sand	10.6
8. Clay, blue, sandy, plastic, fossiliferous	11.7
7. Clay, blue, weathering brown, sandy, micaceous; 1-foot bed of hard limestone at top	19.8

	Thickness Feet
Yazoo clay (restricted)—Continued	
6. Clay, yellow and blue, sectile, with lenses and tube-like bodies of fine sand; a 1.6-foot bed of limestone at the base	10.5
5. Limestone or marl, blue, hard, slightly glauconitic, with 2 feet of blue green very finely sandy, glauconitic and fossiliferous clay at the top	9.7
Moodys Branch formation:	
4. Marl, blue, sandy, glauconitic, soft; contains *Camerina moodybranchensis* Gravell and Hanna and other fossils	3.8
Gosport sand:	
3. Marl, buff to cream, in lower part with scattered subangular to subrounded quartz pebbles, glauconitic and fossiliferous; clay, light-brown and blue-gray, sandy with fine to medium sand and glauconite, carbonaceous films on bedding planes	2.6
2. Sand, blue, medium-grained, slightly clayey, glauconitic, very fossiliferous; contains *Venericardia alticostata* (Conrad), *Glycymeris* sp., and many other species	3.4
Lisbon formation:	
1. Limestone, tan, clayey, finely sandy, slightly micaceous, sparingly fossiliferous; resembles weathered Yazoo clay	2.4

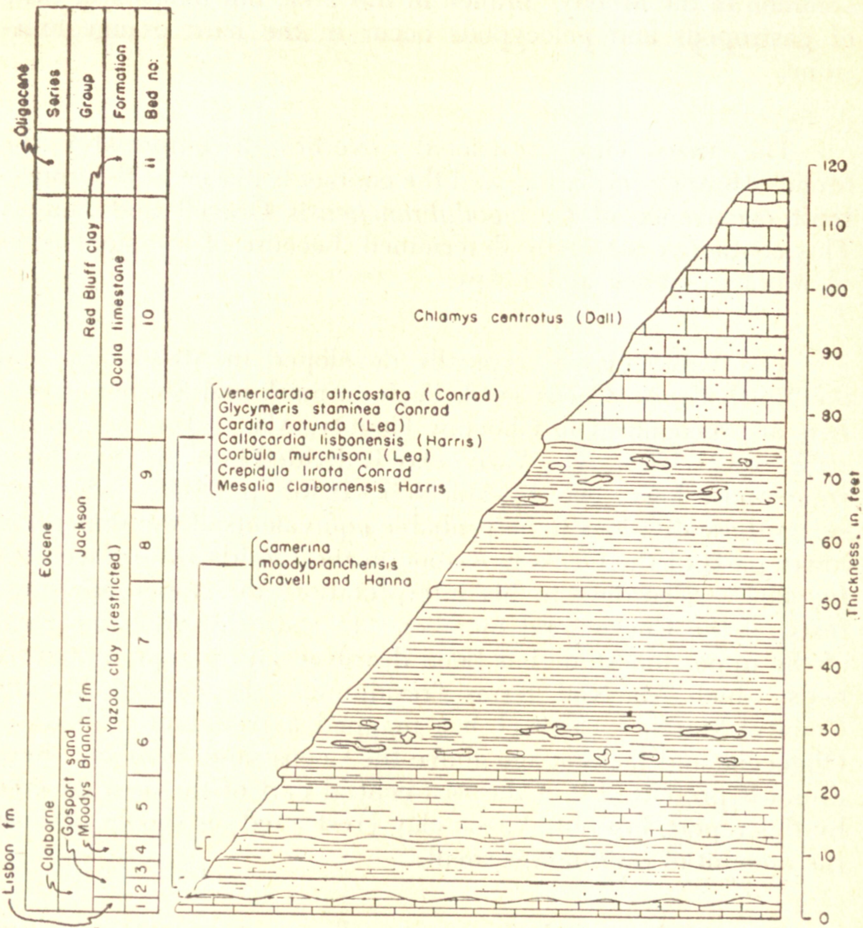

Oligocene
Series
Group
Formation
Bed no.
Eocene
Claiborne
Jackson
Lisbon fm
Gosport sand
Moodys Branch fm
Red Bluff clay
Ocala limestone
Yazoo clay (restricted)
11
10
9
8
7
6
5
4
3
2
1
Chlamys centrotus (Dall)
Venericardia alticostata (Conrad)
Glycymeris staminea Conrad
Cardita rotunda (Lea)
Callocardia lisbonensis (Harris)
Corbula murchisoni (Lea)
Crepidula lirata Conrad
Mesalia claibornensis Harris
Camerina moodybranchensis Gravell and Hanna
120
110
100
90
80
70
60
50
40
30
20
10
0
Thickness, in feet

Figure 28 --Composite geologic section about 2 miles northeast of Monroeville in the NW1/4 sec 30, T 7 N, R 8 E (location 7 on pl. 1)

Stratigraphy and paleontology.—The Moodys Branch formation at the base of the Jackson group overlies disconformably the Gosport sand. The top of the Gosport is usually weathered to an iron-stained fossiliferous, pebbly coarse glauconitic sand which contrasts with the overlying green marl or orange limestone of the Moodys Branch.

The most distinctive fossil in the Moodys Branch formation, *Camerina moodybranchensis* Gravell and Hanna, occurs in the green marl and the orange limestone facies. Megafossils are not common in the Moodys Branch in this area, but molds and casts of gastropods and pelecypods occur in the hard orange limestone.

The Yazoo clay (restricted) overlies disconformably the Moodys Branch formation, and the contact is placed at the uppermost occurrence of *C. moodybranchensis* Gravell and Hanna. This contact is not easily determined, because of the similarities of lithology above and below.

The Yazoo clay is typically developed in Mississippi, and the North Creek, Cocoa sand, Pachuta marl, and Shubuta members are recognized in Choctaw County, Ala. (Toulmin, et al., 1951, p. 121-122). The Yazoo clay is divided into an upper limestone and a lower clay by MacNeil (1946b, p. 43-45), who considers these divisions to be probable equivalents of the upper and lower parts of the Ocala limestone in the Florida subsurface (see fig. 29). According to his interpretation, the upper limestone rests on the Cocoa sand member. In southeast Alabama most of the upper limestone has been dissolved and is represented by beds which MacNeil terms "residuum." In eastern Monroe County, MacNeil (1946a) has mapped a residuum of beds of Oligocene and Jackson age above the Cocoa sand member. Residuum is present also in the east-central part of the area covered by this report, but only Yazoo clay (restricted) is shown because the amount of residuum is small.

Electric logs of shallow test wells penetrating the Jackson group in the Monroeville area show a series of high-resistivity curves covering an interval of 10 to 15 feet near the middle of a section of low-resistivity curves (see figs. 8, 9, 10, 12, 14, 17, and 20). Drill cuttings from the interval of high-resistivity contain more sand than in the interval of low resistivity opposite clay beds. This sand and the overlying 10- to 20-foot clay unit lie immediately below an upper limestone. The sandy interval is probably equivalent to the Cocoa sand member, and the clay beneath the sand is probably equivalent to the North Creek member (see fig. 29). The upper sandy clay, (see fig. 25, beds 1, 2, and 3) and the lower calcareous marl (see fig. 26, beds 4, 5, and 6) in surface exposures are probably equivalent to the Cocoa sand and North Creek members of the Yazoo. These two lithologies are

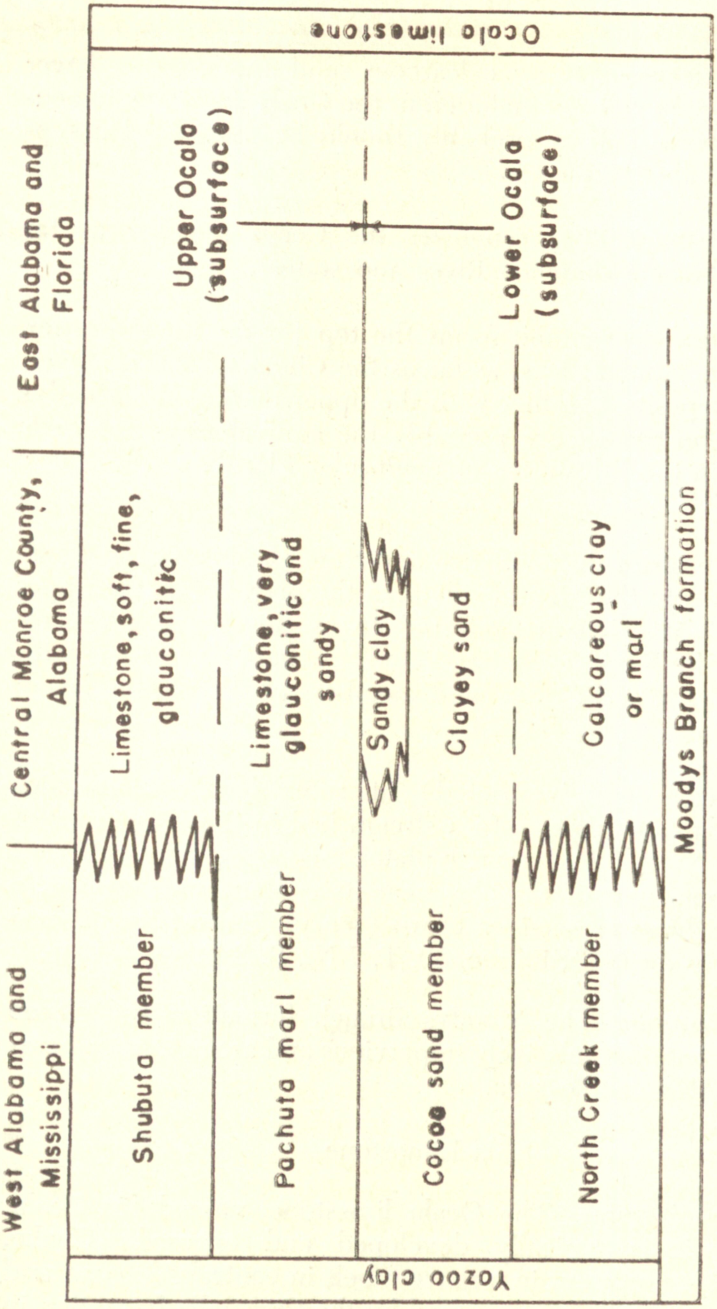

West Alabama and Mississippi
Central Monroe County, Alabama
East Alabama and Florida
Ocala limestone
Shubuta member
Limestone, soft, fine, glauconitic
Upper Ocala (subsurface)
Pachuta marl member
Limestone, very glauconitic and sandy
Cocoa sand member
Sandy clay
Clayey sand
Lower Ocala (subsurface)
North Creek member
Calcareous clay or marl
Moodys Branch formation
Yazoo clay

Figure 29.-- Correlation chart of formations of Jackson age in Mississippi, Alabama, and Florida. (Modified after Toulmin et. al, 1951, in west Alabama, and MacNeil, 1946, in east Alabama.)

discussed by MacNeil (1947) in his correlation chart where he states:

> "17. Calcareous to noncalcareous sand and shale of lower Yazoo age have been included in the Ocala limestone in central Alabama. They probably should be designated a separate member of the Ocala."

MacNeil (1946b,p. 45) recognizes the Cocoa member as far east as the Choctawhatchee River and states:

> "The loose Cocoa sand forms the top [of the lower portion of the Jackson] at least as far as the Choctawhatchee River. These deposits, together with the upper marl of the Moodys Branch formation, are probably the equivalent of the beds known in the subsurface of peninsular Florida as the 'lower Ocala'."

On the basis of this evidence and from electric logs and surface exposures in the Monroeville area the beds below the upper limestone of MacNeil are referred to as the Yazoo clay (restricted). The Yazoo clay (restricted) probably correlates with the North Creek and Cocoa sand members of the Yazoo clay in Choctaw County (see fig. 29).

The Yazoo clay (restricted) at some localities contains abundant barnacle plates. In a stream bed in the NE corner of sec. 25, T. 7 N., R. 7 E., barnacle plates (see pl. 7) were collected from the upper part of the clay near its contact with the Ocala limestone. *Schizaster armiger* Clark (see pl. 7) was found in a stream bed in the NE¼SE¼ sec. 30, T. 7 N., R. 8 E.

Water supply.—The Moodys Branch formation and Yazoo clay (restricted) are relatively impervious and are not water bearing in the Monroeville area.

Ocala Limestone

General features.—The Ocala limestone, named for Ocala, Fla., where it is typically developed and exposed (Cooke, 1926, p. 275), crops out in a narrow belt in central Alabama and Monroe County, and is overlapped by the Citronelle formation in most of the Monroeville area. The best exposures of the Ocala occur in gullies north of the city and along the southwest side of the valley cut by Double Branches. At the land surface the Ocala typically forms low, rolling hills.

Thickness and lithology.—The Ocala limestone is 27 feet thick along the creek that flows eastward across the north border of sec. 8 and the south border of sec. 5, T. 6 N., R. 8 E., and is 41 feet thick in the creek that flows east across the southern part of sec. 31, T. 7 N., R. 8 E. The thicknesses measured in surface exposures of Ocala limestone check favorably with thicknesses in the shallow test wells.

In fresh exposures the Ocala limestone is cream to buff sandy material containing fossils and with medium-grained angular quartz sand and light to dark-green glauconite. Weathered outcrops of the Ocala limestone retain some of the original calcareous appearance but where extensively weathered are chiefly medium-grained angular clear quartz sand with glauconite. Weathered exposures are yellowish, iron stained, very sandy and glauconitic, and contain fossils which appear to have been replaced by brown siderite in the lower part of the formation.

An exposure of the Ocala limestone along the Louisville & Nashville Railroad north of Drewry is very fossiliferous and shows two lithologies (see fig. 30). The upper part is soft, sparingly glauconitic, fossiliferous limestone; the lower part is locally hard crystalline limestone containing coarse glauconite and abundant fossils.

Partial geologic section of Ocala limestone about 1 mile north of Drewry along Louisville & Nashville Railroad in SE¼SW¼ sec. 10, T. 6 N., R. 8 E.
(Location 8 on pl. 1)

	Thickness Feet
3. Cover containing Citronelle sand and gravel	3+
Ocala limestone:	
2. Limestone, cream, soft, sparsely glauconitic, with a fossiliferous bed near the top containing *Lepidocyclina* sp., *Chlamys spillmani* (Gabb)?, and *Laganum johnsoni* Twitchell	4.6

1. Limestone, buff, iron-stained, very coarsely glauconitic, locally crystalline and leached at surface; fossiliferous with *Chlamys spillmani* (Gabb) and *Periarchus lyelli pileussinensis* (Ravenel); much slump from above 14-16

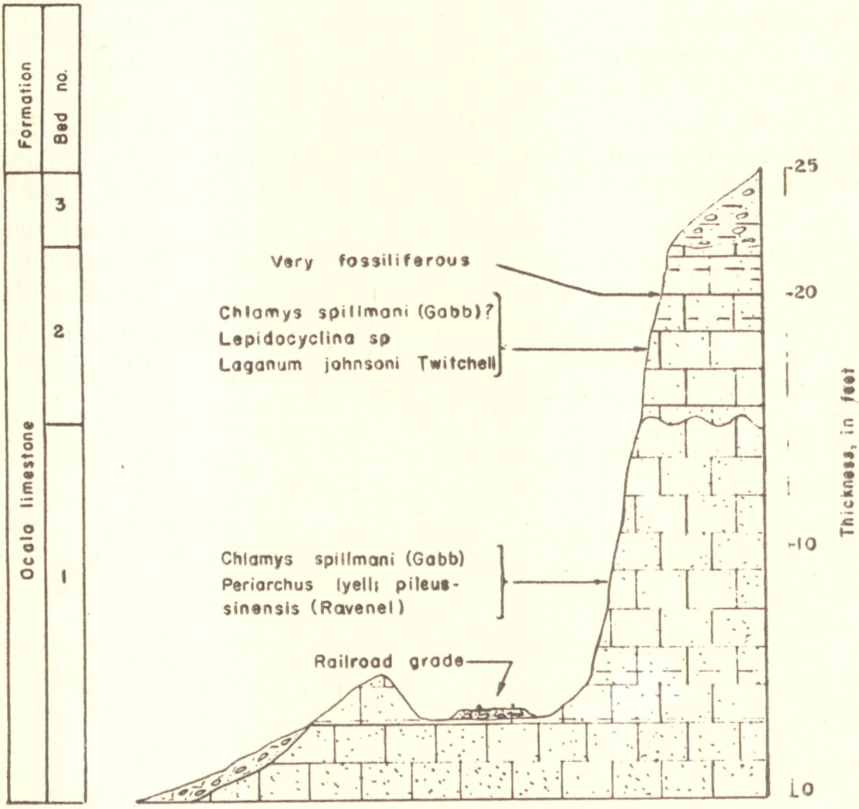

Formation
Bed no.
Ocala limestone
3
2
1
Very fossiliferous
Chlamys spillmani (Gabb)?
Lepidocyclina sp
Laganum johnsoni Twitchell
Chlamys spillmani (Gabb)
Periarchus lyelli pileus-sinensis (Ravenel)
Railroad grade
25
20
10
0
Thickness, in feet

Figure 30.--Partial geologic section of Ocala limestone about 1 mile north of Drewry in Louisville & Nashville Railroad cut in SE 1/4 SW 1/4 sec. 10, T. 6 N., R. 8 E. (location 8 on pl. 1).

A good exporsure of the Ocala occurs in the creek bed in the S½ sec. 31, T. 7 N., R. 8 E. (see fig. 31). The boundary between the upper and lower parts of the Ocala is not as clearly marked as in the section shown in figure 30, but the two lithologies can be distinguished.

Geologic section in creek bed in S½ sec. 31, T. 7 N., R. 8 E.
(Location 9 on pl. 1)

	Thickness Feet
Citronelle formation:	
7. Sand, gravel, and variegated clay	5+
Marianna limestone:	
6. Limestone, white to cream, soft, sparsely glauconitic, fossiliferous	1.5-3
Red Bluff clay (limestone facies):	
5. Limestone, buff to light-brown, clayey, finely glauconitic, fossiliferous with *Spondylus* n. sp. (?)	5.0
4. Limestone, buff to light-brown, clayey, finely glauconitic, fossiliferous, with phosphate replacements of *Astarte triangulata* Meyer, coral, fish vertebrae, etc., and phosphatic pebbles	2.0
Ocala limestone:	
3. Limestone, buff to cream, slightly glauconitic and sandy in the upper part, fossiliferous with *Schizaster armiger* Clark, *Macropneustes mortoni* (Conrad). Lower part buff to yellow when weathered, very glauconitic and sandy and contaning *Eupatagus* (*Plagiobrissus*) *ocalanus* Cooke, and *Periarchus lyelli pileus-sinensis* (Ravenel)	40(?)
2. Limestone, white to buff, hard, glauconitic, with molds and casts of fossils	1.4
Yazoo clay:	
1. Clay, blue-green, blocky, fossiliferous	2.5+

Stratigraphy and paleontology.—The Ocala limestone is overlain disconformably by the Red Bluff clay (limestone facies). The lower 3 to 5 feet of the Red Bluff contains phosphatic pebbles, phosphatic replacements of fossils, and worm borings. The contact between the Ocala and Red Bluff is considered to be at the lower limit of phosphatic reworking in the bed.

The Ocala lies disconformably on the Yazoo clay (restricted), and the contact between the two formations is marked by an abrupt change in lithology. A 1- to 2-foot bed of hard, glauconitic white limestone containing abundant molds and casts of fossils occurs in most exposures at the base of the Ocala (see fig. 31). The basal 6 inches of the Ocala contains reworked plates of Yazoo clay (restricted) in the NW¼NE¼ sec. 27, T. 7 N., R. 7 E. (see fig. 25), and the hard limestone is not present.

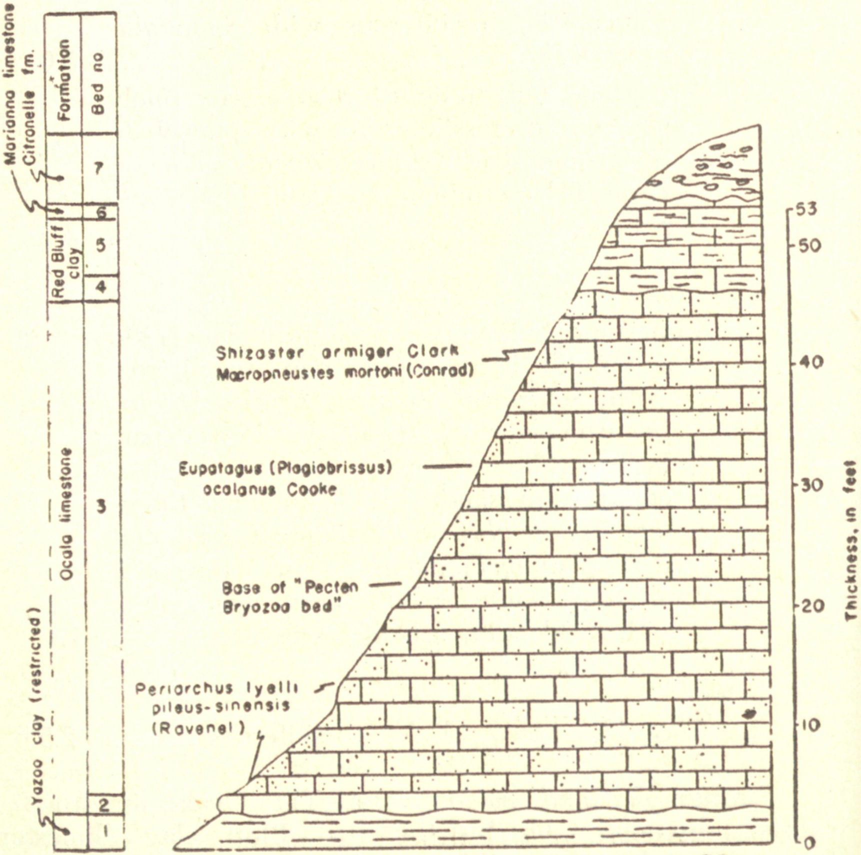

Marianna limestone
Citronelle fm.
Formation
Bed no
7
6
5
4
3
2
1
Red Bluff clay
Ocala limestone
Yazoo clay (restricted)
Shizaster armiger Clark
Macropneustes mortoni (Conrad)
Eupatagus (Plagiobrissus) ocalanus Cooke
Base of "Pecten Bryozoa bed"
Periarchus lyelli pileus-sinensis (Ravenel)
53
50
40
30
20
10
0
Thickness, in feet

Figure 31 -- Geologic section in creek bed in S 1/2 Sec 31, T7N. R 8E (location on Pl 1)

In central Alabama east of the Tombigbee River, strata of late Jackson age are referred to as Ocala limestone by MacNeil (1947) and by Toulmin, et al. (1951, p. 36). The Ocala was not divided by MacNeil, although he stated that the "Zeuglodon bed" was its basal member. Toulmin et al. also indicate that the Pachuta marl member of the Yazoo clay in Choctaw County, Ala. merges eastward into the Ocala limestone.

The lower, coarsely sandy and glauconitic part of the Ocala in the Monroeville area has essentially the same lithology as that of the Pachuta marl member described by Toulmin, et al. (1951, p. 122) and the two are probably equivalent. The upper soft, finely glauconitic Ocala limestone is possibly a more sandy glauconitic facies of the calcareous clay with lime concretions in the Shubuta member of the Yazoo clay. These beds in central Monroe County are probably the equivalent of the upper Ocala in the subsurface of peninsular Florida according to MacNeil (1946b, p. 43). The Pachuta marl member is the "Zeuglodon" (*Basilosaurus cetoides*) or Pecten-Bryozoa bed of the Yazoo clay. A vertebra of a "Zeuglodon" was found by P. E. LaMoreaux (personal communication, May 1951) in the lower part of the Ocala in the S½ sec. 31, T. 7 N., R. 8 E. Although the bone was not found in place, it probably had not been washed far from its original position.

In the measured section in the SE¼SW¼ sec. 10, T. 6 N., R. 8 E. (see fig. 30), beds 1 and 2 may be equivalent to the Pachuta marl and Shubuta members of the Yazoo clay in Choctaw County, Ala.

The following fossils were collected from the Ocala limestone in the creek bed in the S½ sec. 31, T. 7 N., R. 8 E.:

Chlamys sp.
Macropneustes mortoni (Conrad)
Schizaster armiger Clark
Eupatagus (*Plagiobrissus*) *ocalanus* Cooke
Lepidocyclina sp.
Periarchus lyelli (Conrad)
Periarchus lyelli pileus-sinensis (Ravenel)
Laganum johnsoni Twitchell

Schizaster armiger appears throughout the Ocala section, especially in the upper, finely glauconitic part. This echinoid is associated with a larger echinoid, *Macropneustes mortoni,* in the upper 4 to 5 feet of the Ocala, and the two fossils appear together near the Ocala-Red Bluff contact, *M. mortoni* being restricted to this upper Ocala zone. The small pecten identified as *Chlamys* sp. is found throughout the Ocala. A spiny-ribbed pecten, *Chlamys spillmani* (Gabb), is usually found in the lower part of the formation. Actually the small *Chlamys* may be the young of *C. spillmani.*

The lower, coarsely glauconitic and very sandy limestone in the Ocala contains abundant echinoids of the genus *Periarchus;* the species are *lyelli,* and *lyelli pileus-sinensis.* Two localities where these fossils are best exposed are in the SW¼SE¼ sec. 31, T. 7 N., R. 7 E., and in the NE corner sec. 25, T. 7 N., R. 7 E. Large *Chlamys spillmani* (Gabb) (see pl. 8) is found associated with *Periarchus* in the section north of Drewry (see fig. 30). Other fossils found in the Ocala are *Chlamys centrotus* Dall, *Brissopsis* sp. cf B. *steinhatchee* Cooke, *Periarchus lyelli pileus-sinensis* (Ravenel), *Eupatagus* (*Plagiobrissus*) *ocalanus* Cooke, *Schizaster armiger* Clarke, and corals (see pls. 8 and 9).

Water supply.—Several springs occur at the contact of the Ocala limestone and Yazoo clay (restricted) where fractures in the Ocala have been enlarged sufficiently by solution to allow substantial downward percolation of water to the impermeable clay. Water coming in contact with the clay moves laterally to the intersection of the clay with the land surface.

Wells 1 and 83 (see table 1) develop water from sandy, fossiliferous beds in the Ocala limestone.

Quality of water.—A sample of water for partial chemical analysis was taken from well 1 (see table 2). Iron, chloride, fluoride, nitrate, and sulfate in this water were low, but bicarbonate was relatively high, 285 ppm. The water had the highest observed hardness from any well in the area, 264 ppm, indicating the limy character of the aquifer. The water was slightly alkaline, having a pH of 7.7.

OLIGOCENE SERIES

Red Bluff Clay (limestone facies)

General features.—The Red Bluff clay, named by Hilgard (1860, p. 136) for Red Bluff on the Chickasawhay River in Mississippi, is a limestone in the Monroeville area, and is designated the Red Bluff clay (limestone facies) (MacNeil, 1947). The clay facies of the Red Bluff is recognized at least as far east as Choctaw County, Ala. (Toulmin, et al., 1951, p. 128). The limestone facies is traced eastward to the Monroeville area by MacNeil (1944, p. 1321-1324). It is at the base of the Oligocene series, and in this report, is mapped with the Marianna limestone of the Vicksburg group (see pl. 1). It is found well exposed in gullies north and east of Monroeville, but was not found in the two gullies northeast of Drewry where the Ocala-Marianna contact is mapped. MacNeil (1944, p. 1323) did not recognize the Red Bluff east of a point three-quarters of a mile north of Drewry.

Thickness and lithology.—The Red Bluff clay at the surface has an average thickness of 8 feet. In the subsurface the Red Bluff clay is 13 feet thick, and is indicated on electric logs by a low resistivity curve (see figs. 8, 9, 10, 12, 14, 17, and 20).

MacNeil (1944, p. 1318) states that the Red Bluff becomes a soft limestone eastward in Alabama and is traceable as far east as Monroe County, beyond which, if present, it is not separable from the Marianna limestone although paleontological evidence might be found in the future for distinguishing it.

The Red Bluff is about 6 to 8 feet thick where it is exposed in the SE¼NE¼ sec. 26, T. 7 N., R. 7 E. The lower part of the Red Bluff is calcareous sandy clay or clayey sand containing sparse glauconite, phosphatic worm borings, pebbles, and replacements of fossils. The upper part of the Red Bluff contains less glauconite than the lower part.

A good exposure of Red Bluff in the SW¼ sec. 31, T. 7 N., R. 8 E., consists of soft, clayey sandy glauconitic limestone contraining phosphatic borings, *Spondylus dumosus* (Morton), fish vertebrae and irregularly shaped pebbles. The Red Bluff is exposed also in the gullies to the south, in secs. 6 and 8, T. 6 N., R. 8 E.

Stratigraphy and paleontology.—The contact of the Red Bluff clay (limestone facies) with the Ocala limestone is marked by a zone of reworked phosphatic material. The lower part of the zone is in the Jackson group (Ocala) and contains phosphatic borings and other fossils in place; the upper part is within the Red Bluff (Oligocene) and contains phosphatic pebbles and reworked fossils from the Jackson group. In this report the complete phosphatic section is included in the Red Bluff.

The contact of the Red Bluff with the overlying Marianna limestone is apparently conformable in the Monroeville area; however, MacNeil (1944, p. 1323) observed a zone of glauconite-filled borings overlain by a 1-foot ledge of tough limestone at the base of the Marianna limestone. This zone was not observed in the Monroeville area, and the highest point where the large heavy-shelled *Spondylus dumosus* occurs is taken as the contact of the Red Bluff and the Marianna.

The Red Bluff clay (limestone facies) contains phosphatized replacements of *Astarte triangulata, Glycymeris arctatus,* coral (reworked Ocala species), and worm tubes. *Spondylus dumosus* (Morton) and *Ostrea vicksburgensis* Conrad are guide fossils for the Red Bluff (see pls. 8 and 10). A smaller, more delicate *Spondylus,* possibly a new species, is found in the overlying Marianna limestone.

Water supply.—The Red Bluff clay (limestone facies) is thin and relatively impermeable in the Monroeville area. It is not important as a source of water supply.

Vicksburg Group

The Vicksburg group consists of limestone and clay in the Monroeville area. In places the limestone contains extensive solution-cavity systems that are water-bearing and supply water to municipal, industrial and private wells.

Marianna Limestone

General Features.—The Marianna limestone was named from exposures at Marianna, Fla. (Cooke, 1926, p. 280). It is called "chimney rock" because blocks of it were once used extensively for building chimneys. Many exposures of the Marianna in the gullies around Monroeville show evidence of quarrying.

The Marianna limestone crops out in Limestone and Little Limestone Creeks in the southeastern part of the Monroeville area, and in Double Branches and its tributaries. It weathers to clayey soil, and forms rolling hills.

A natural cave in the Marianna, a short distance up an eastward-flowing tributary of Rock Pit Branch, has a high narrow opening which appears to have been formed along a joint. About 3 feet of water stands in the cave.

Thickness and lithology.—The Marianna limestone is about 80 feet thick in the Monroeville area. It consists of homogenous white to cream soft, porous fossiliferous limestone. Drill cuttings from wells show a large amount of fine calcareous material containing Foraminifera. Soft friable Marianna limestone containing sparse glauconite is exposed in the railroad cut in the SW cor. SE¼ sec. 3, T. 6 N., R. 7 E. Glauconite is not generally found in the limestone, but where present it is fine grained and dark green. Hard ledges or lenses of limestone, generally less than 2 feet thick, occur locally in the Marianna. Much of the ground surface in the NE¼SW¼ sec. 33, T. 7 N., R. 7 E., is bare Marianna limestone that crops out on a hill slope. At this locality 75 feet of Marianna is exposed from the base of the hill to the contact with the Glendon limestone member above. Weathered surfaces of the Marianna are light gray, are slightly indurated, and form a hard crust. Cream-colored soft, porous fossiliferous limestone is exposed when the weathered shell is broken.

The Marianna is exposed in the bed and along the banks of Rock Pit Branch in the SW¼ sec. 4, T. 6 N., R. 7 E. The contact of the Marianna and the Glendon limestone member of the Byram formation is well exposed in the SE¼SW¼ sec. 4, T. 6 N., R. 7 E., where the Glendon forms the roof of a cave which has been quarried in the Marianna (see pl. 6). A hard ledge of Glendon projects over the soft Marianna at another exposure in the NW¼NE¼SE¼ sec. 4, T. 6 N., R. 7 E.

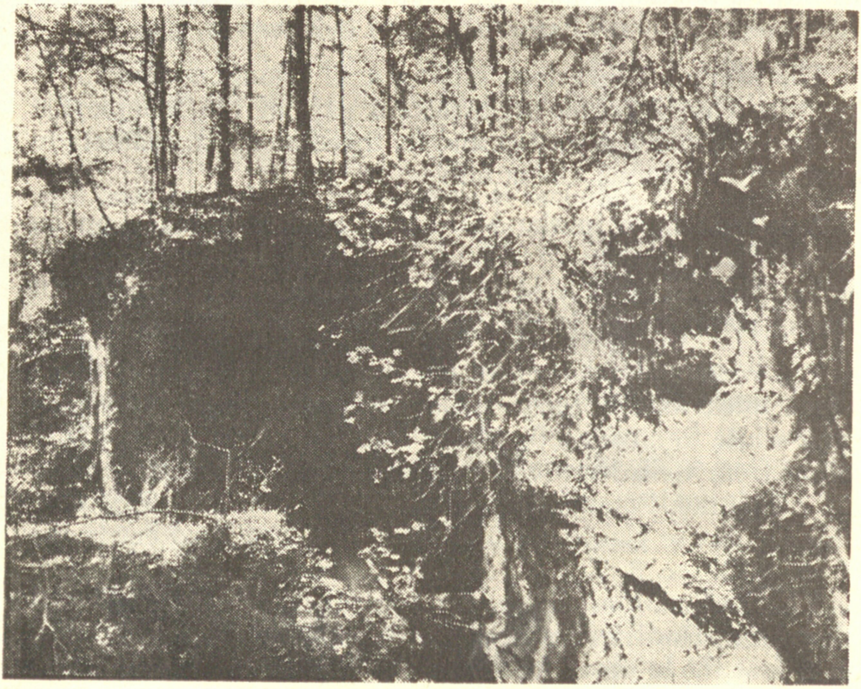


Plate 6—Cave in the Marianna limestone on Rock Pit Branch in the SE¼SW¼ sec. 4, T, 6 N., R. 7 E. The Glendon limestone member of the Byram formation forms the roof of the cave.

Stratigraphy and paleontology.—The Marianna limestone overlies the Red Bluff clay conformably in the few exposures of the contact found in the Monroeville area. The two formations grade together imperceptibly, and the contact is chosen arbitrarily at the highest point at which the large *Spondylus dumosus* (Morton) of the Red Bluff is found.

Soft cream-colored massive Marianna limestone is overlain disconformably by the hard, nodular light-gray Glendon limestone member of the Byram formation, which contains a complex network of solution cavities ranging from less than an inch across to more than 6 inches.

The Marianna limestone contains abundant mega- and microfossils. The echinoid *Clypeaster rogersi* (Morton) (see pl. 11) occurs in the upper 20 or 30 feet of the formation but is not confined to this zone. *Pecten poulsoni* Morton, *Ostrea vicksburgensis* Conrad and *Lepidocyclina mantelli* (Morton) are scattered throughout the Marianna (see pls. 10 and 11). Locally, *L. mantelli* occurs very abundantly. Abundant Bryozoa and Foraminifera were found in cuttings of Marianna limestone from several of the shallow test wells, however, in general the lower 20 feet of the formation contains a larger percentage of Foraminifera, the upper part a predominance of Bryozoa.

The Marianna is exposed at the east end of the lake in Vanity Fair Park, at the southwest corner of the city limits. At this locality it is white to cream limestone containing abundant fossils, including Bryozoa, *Pecten poulsoni*, *Spondylus* n. sp., *Ostrea vicksburgensis*, and *Lepidocyclina mantelli*. The *Spondylus* is smaller and more delicate than the S. *dumosus found* in the Red Bluff clay.

Water supply.—Solution cavities in the Marianna limestone supply water to private and municipal wells in the Monroeville area. The city obtained water for many years from wells C-1 and C-2 (see table 1) developed in the Marianna. These wells had yields of 175 gpm and 130 gpm, respectively, in 1952. Shallow test wells ST-9, ST-11, ST-12, and ST-13 (see table 1) penetrated the upper part of the Marianna. Test well ST-9 penetrated a series of solution cavities between 69 and 130 feet and ST-13 penetrated cavities at 99 to 129 feet. Well ST-13 was test pumped for 6 hours at the rate of 102 gpm on May 31, 1952, and had a drawdown of 45 feet indicating a specific capacity of 2.3 gpm per foot of drawdown. Wells 20, 25, and 85 penetrated solution cavities in the Marianna (see table 1), and wells 52, 72, 73, and 84 are also possibly developed in this aquifer.

Isolated patches of the limestone on the pre-Citronelle erosion surface may be good aquifers where the Citronelle is permeable enough to supply water freely to the limestone (see pl. 1).

Quality of water.—Partial chemical analyses were made of water samples from wells 20 and 84, and a complete analysis was made of water from ST-9 (see table 2). The quality of water from solution cavities was fairly uniform; hardness ranged from 83 to 118 ppm, bicarbonate from 92 to 135 ppm, and iron from 0.04 to 0.46 ppm. The pH ranged from 7.3 to 7.7, and sulfate, nitrate, chloride and fluoride contents were low. The water is moderately hard, but of general good quality for most municipal, industrial and domestic uses.

Byram Formation

General features.—The Byram formation was first called the Byram beds by Casey (1901, p. 517-518) for exposures on Pearl River near Byram, Miss. Cooke (1918, p. 186-198) later gave it formation rank, calling it the Byram calcareous marl. MacNeil (1947) expanded the Byram formation to include the Glendon limestone member below and the Bucatunna clay member above the typical marl member.

The Byram formation is exposed in gullies tributary to Double Branches southwest of Monroeville. It occurs south of Monroeville below a cover of sand, gravel, and clay of the Citronelle formation which overlaps the Bucatunna clay member.

According to MacNeil (1944, p. 1332) the Bucatunna clay member was named for exposures along Bucatunna Creek near Dyess Bridge in Wayne County, Miss. It was described as a separate formation in the Guidebook of the Eleventh Field Trip of the Shreveport Geological Society in 1934.

Good exposures of Bucatunna can be found in the stream beds which cut across its outcrop in the southeastern part of the area. The Bucatunna clay member of the Byram formation in the southwestern part of this area usually forms a gentle slope extending from the base of the Citronelle formation to the top of the ledge-forming Glendon. Ellipsoidally-shaped clay boulders and cobbles are found downstream from the outcrops of the Bucatunna. These fragments of clay become more rounded and smaller the farther they have been transported.

The Glendon limestone was named by Cooke in an unpublished report for the Mississippi Geological Survey for exposures at Glendon, Clarke County, Ala., but the term Glendon was first published by Hopkins (1917, p. 298, 300), who gave recognition to Cooke's previous work. The marl member of the Byram formation is mapped with the Glendon limestone member for this report (see pl. 1).

The Glendon limestone member is more resistant to erosion than either the underlying Marianna limestone or the overlying Bucatunna clay member, and forms a distinct topographic bench in fresh exposures. Weathered boulders of Glendon have the appearance of bleached animal bones, a characteristic which has given this formation the name "horsebone."

Thickness and lithology.—The Glendon limestone member is about 20 feet thick and consists of light-gray crystalline hard dense, fossiliferous limestone containing soft streaks and tubular solution cavities. About 20 feet of Glendon was measured in the cut on the south side of the road and in a gully on the north side of the road in the NW¼SW¼ sec. 2, T. 6 N., R. 7 E. The full thickness of the Glendon is well exposed about 4 miles south of the area mapped, in a road cut just south of where the Frisco City cutoff from Highway 84 crosses Randons Creek.

The marl member of the Byram formation consists of about 5 feet of yellow to orange limestone which is hard, dense, and fossiliferous. The colors vary from light gray in the Glendon to orange in the marl.

Section in road cut south of Randons Creek in the SW¼ sec. 15, T. 6 N., R. 6 E. (Not shown on pl. 1)

	Thickness Feet
Byram formation:	
Bucatunna clay member:	
5. Rubble of clay, tan, gray and brown, variegated, plastic and fissile, weathered	5+
Marl member:	
4. Limestone, orange, dark tan when weathered, massive, hard, fossiliferous with *Chlamys Anatipes* (Morton) and an unidentified *Pecten*	5.5
Glendon limestone member:	
3. Limestone, white to gray, hard and dense but containing soft streaks and solution cavities, which give it "horsebone" appearance. Contains ledges consisting almost entirely of shells of *Lepidocyclina* sp., with *Pecten byramensis* Gardner, *Chlamys anatipes* (Morton) and *Ostrea vicksburgensis* Conrad	14
2. Limestone, white, softer than bed 3; has large solution cavities filled with clay in lower part	7
Marianna limestone:	
1. Limestone, cream, soft, porous, with abundant *Lepidocyclina* sp.	1±

The marl member of the Byram formation is well exposed where the stream flows underground at the contact of the marl member and the underlying Glendon limestone member in the SW¼NW¼SW¼ sec. 4, T. 6 N., R. 7 E. (see fig. 32).

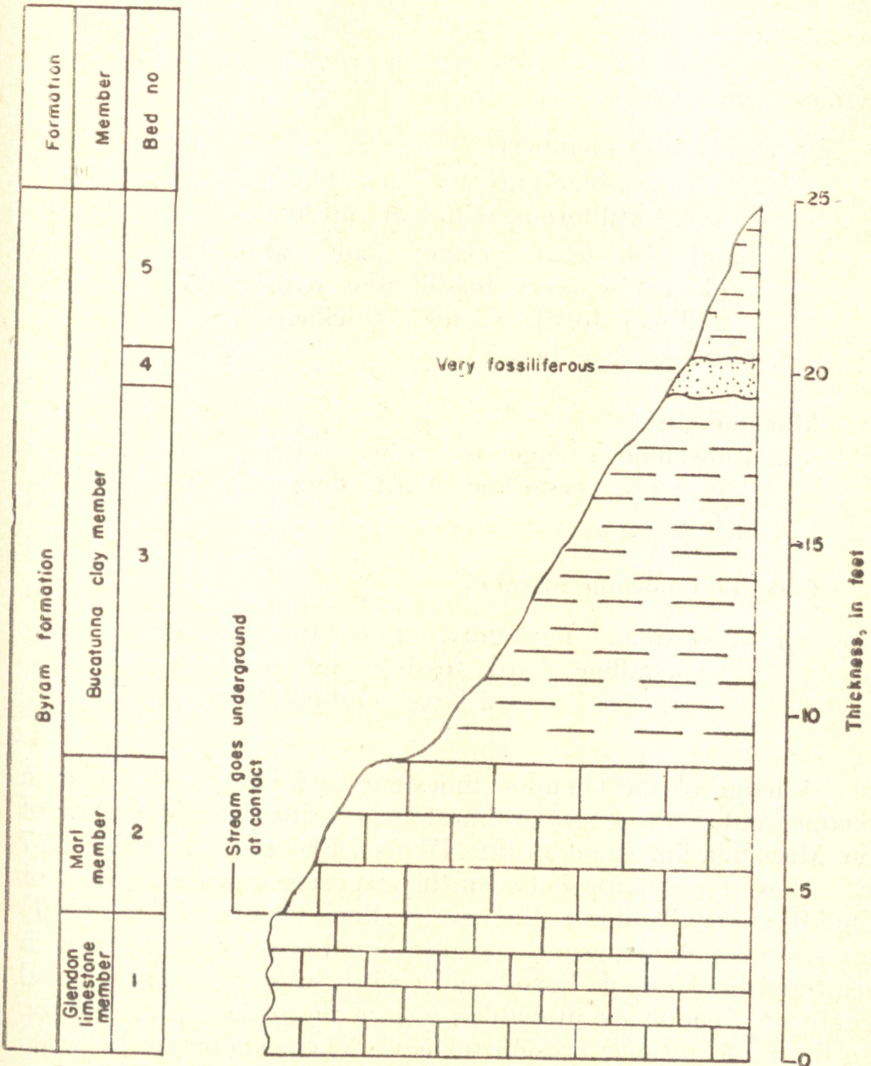

Formation
Member
Bed no
Byram formation
Bucatunna clay member
Marl member
Glendon limestone member
5
4
3
2
1
Very fossiliferous
Stream goes underground at contact
25
20
15
10
5
0
Thickness, in feet

Figure 32 -- Geologic section about 3 miles southwest of Monroeville in SW 1/4 NW 1/4 SW 1/4 sec. 4, T 6 N, R 7 E. (location 10 on pl. 1)

Geologic section about 3 miles southwest of Monroeville in the SW¼NW¼SW¼ sec. 4, T. 6 N., R. 7 E. (Location 10 on pl. 1)

	Thickness Feet
Byram formation:	
Bucatunna clay member:	
5. Clay, dark-blue-gray to black, blocky, massive, fossiliferous, with leaf imprints	6+
4. Sand, blue-gray, clayey, and abundant glauconite, very fossiliferous with micro- and megafossils. Varies in thickness	1+
3. Clay, same as bed 5	10-15±
Marl member:	
2. Limestone, orange to brown, medium to coarsely crystalline, hard, dense, fossiliferous	4.5
Glendon limestone member:	
1. Limestone, light-gray, fine to medium, crystalline, hard, fossiliferous, very cavernous. Forms a large solution cavity	5+

A ledge of the Glendon limestone member projects over a scooped-out section of softer limestone, considered to be the top of the Marianna limestone, in the NW¼NE¼SE¼ sec. 4, T. 6 N., R. 7 E. Along the outcrop between this exposure and the contact of the Marianna-Glendon at the cave on Rock Pit Branch (see pl. 6) are several good exposures and weathered areas of Glendon with scattered boulders of "horsebone" rock. Subsurface patches and knobs of Glendon are probably north of the main line of outcrop on the pre-Citronelle erosion surface. These knobs are believed to extend at least as far north as the southeastern part of Monroeville.

The Bucatunna clay member consists of dark-blue-gray to brown massive, blocky clay, locally containing lenses of clayey, glauconitic sand. These lenses usually contain abundant micro-

and macrofossils. Plant fragments and carbonaceous films are scattered throughout the clay and a 4-inch lignite bed is found in the SE¼NE¼ sec. 9, T. 6 N., R. 7 E.

Wells a short distance southwest of Monroeville, in the Mexia area, penetrate more than 50 feet of Bucatunna.

A bed of fossiliferous glauconitic clayey sand is estimated to be about 10 feet above the contact of the Glendon and Bucatunna in Rock Pit Branch in the SE cor. SW¼ sec. 4, T. 6 N., R. 7 E. This bed possibly correlates with the bed of clayey glauconitic fosssiliferous sand found 10 to 15 feet above the base of the Bucatunna in the SW¼NW¼SW¼ sec. 4, T. 6 N., R. 7 E. (see fig. 32).

Weathered clay is well exposed in a road cut on Highway 84 about 1½ miles southwest of Monroeville in the SW¼ sec. 2, T. 6 N., R. 7 E. Contorted bedding in the clay may represent slumping or faulting; however, conclusive evidence of faulting could not be found in nearby exposures of the Marianna limestone and Glendon member. It is possible that a fault affecting the Glendon limestone and Bucatunna clay members in the NE¼ sec. 9, T. 6 N., R. 7 E. may extend into this area.

Stratigraphy and paleontology.—The Glendon limestone member is overlain disconformably by the marl member (see fig. 32). The change from white and gray limestone in the Glendon to orange and pink limestone in the marl member is easily recognized. Westward in Choctaw County, Ala., and in Mississippi the marl member becomes a soft marl unlike the exposure in the Monroeville area.

The Glendon limestone and marl members of the Byram formation are very fossiliferous. The Glendon member contains abundant *Lepidocyclina supera* (Conrad), which locally form a coquina, and abundant *Pecten byramensis* Gardner, *Chlamys anatipes* (Morton), *Clypeaster rogersi* (Morton), and *Ostrea vicksburgensis* Conrad. The marl member of the Byram contains *O. vicksburgensis* and *Chlamys anatipes* and the characteristic *Pecten byramensis* Gardner with shouldered ribs, which also occurs in the underlying Glendon. See plates 11 and 12 for some of the above fossils.

Throughout the Bucatunna clay member are pelecypods, corals, and plant remains, but the greatest accumulation of fossils is in the sandy glauconitic beds. Fossils (see pl. 12) collected by the writer in the area of outcrop, in the SW¼SE¼ sec. 4, T. 6 N., R. 7 E., were identified by F. S. MacNeil of the U. S. Geological Survey as follows:

Anadara mississippiensis (Conrad)
Pecten byramensis Gardner
Nemocardium diversum (Conrad)
Dentalium mississippiensis (Conrad)
Balanophyllia aff. *B. caulifera* (Conrad)

Water supply.—The Glendon limestone member including the marl member is a good aquifer in the Monroeville area. Shallow test wells 4 and 6 which were converted into observation wells, and wells 20, 25, 30-34 and 56 (see table 1) penetrated solution cavities in the Glendon. All these wells, according to their owners, furnish adequate water for domestic use.

The Bucatunna clay member of the Byram formation is not an aquifer in the Monroeville area.

Quality of water.—Water from the Glendon limestone and the marl members of the Byram formation is moderately hard to hard, and samples of water taken from wells 30 and 33 in the Glendon limestone member had a hardness of 138 ppm, and a pH of 8.0 and 8.1 respectively. It is a calcium bicarbonate water.

PLIOCENE SERIES

MacNeil (1946a) mapped rocks of Miocene age in the southern part of the Monroeville area. In this report all deposits younger than the Byram formation and older than Pleistocene are included in the Citronelle formation.

Fluviatile deposits of fine to very coarse clastic sediments were deposited in the Monroeville area during late Pliocene time. Alternating floods and quiet flow of the ancestral Alabama River deposited this heterogeneous blanket of channel and flood plain sediments over much of southern Alabama on an erosional surface of older rocks. These beds act as a sponge absorbing rainfall and feeding it slowly into underlying deposits. Many shallow wells are developed in these deposits.

Citronelle Formation

General features.—The Citronelle formation was named by Matson (Matson and Berry, 1916, p. 168) for the town of Citronelle in Mobile County, Ala. The Citronelle formation covers much of the Monroeville area, forming a gently rolling plain and crops out in the central and southern parts of the area mapped (see pl. 1). A veneer of wash derived from the Citronelle covers the older rocks in many places, and the formation has been mapped where this veneer is relatively thick. In many places streams have cut narrow, steep-walled gullies, exposing the older rocks as well as the Citronelle north and northwest of the city.

There is a slight topographic break at the contact of the Citronelle and underlying formations. However, this break is not easily recognizable where large quantities of sand and gravel from the Citronelle have washed over the older rocks.

Thickness and litholology.—The thickness of the Citronelle is variable throughout the report area, but it increases southward from the rim of the north-facing escarpment overlooking the valley of Limestone Creek. Sixty to 150 feet of Citronelle was encountered in shallow test wells drilled in the Monroeville area.

The Citronelle formation consists of predominantly quartz sand and gravel, and clay, which is generally red to orange on weathered surfaces. Unweathered sand and gravel varies in color from white to orange, and the clay is variegated red, orange, purple, yellow and white. The sand is usually angular and fine- to very coarse-grained; the gravel is subrounded and predominantly pebble-sized, although it contains a few cobbles. The size of the gravel appears to increase toward the east in the report area. The clay is relatively free of coarser clastic material in some beds but contains a moderate to large amount of sand or gravel in others. Scattered boulders of limonite-cemented conglomerate containing quartz pebbles and sand occur locally in the outcrop area of the Citronelle.

The Citronelle is irregularly bedded with lenses and streaks of sand, gravel and clay grading laterally into each other within a few to several hundred feet (Matson and Berry, 1916, p. 168). The sand and fine gravel are locally cross-bedded.

Numerous good exposures of this formation are found in the report area. An exposure of variegated clay occurs in the gully on the southwest side of the road leading northwest from Clausell Quarters, in the NW¼ sec. 34, T. 7 N., R. 7 E. Exposures of pebble and cobble-sized gravel can be seen in the central part of sec. 17, T. 6 N., R. 8 E., about 3¼ miles southeast from Monroeville toward Drewry.

Stratigraphy and paleontology.—The geologic mapping and test drilling for this investigation indicate that the Citronelle overlaps progressively older formations from south to north with pronounced unconformity. The relief on the irregular surface of the older formations on which the Citronelle formation was deposited, was found by test drilling to be about 130 feet. This irregular surface is thought to be the combined result of the pre-Citronelle erosion and the post-Citronelle solution of soluble limestones.

The contact of the Citronelle with the underlying soft Marianna and Ocala limestones in many places shows a dark-brown or black residual clay formed by weathering of the limestone. Beds of gravel and sand in the subsurface usually overlie the limestone.

The Citronelle formation in the report area contains no fossils.

Water supply.—Wells developed in the Citronelle formation supply water to most of the farms in the report area and to a few industries (see table 1). Many farm wells are shallow and become dry seasonally when the water table drops below the well bottoms. Wells put down for domestic supplies are usually bored or dug by hand auger, and those used for industrial supplies are drilled.

Quality of water.—Water samples were taken from 3 wells developed in the Citronelle formation for partial chemical analysis (see table 2). The analyses show the water is very soft, the hardness ranging from 16 to 24 ppm, and high in iron content, ranging from 0.23 to 4.8 ppm. Study of the analyses also indicates the water from the Citronelle is probably low in dissolved solids.

PLEISTOCENE AND RECENT SERIES

General features.—Stream terrace deposits and alluvium lie unconformably on older rocks in the vicinity of the main streams in the Monroeville area. These beds range in thickness from a few inches to as much as 50 feet and consist mainly of lenticular unconsolidated clay, silt, sand and gravel eroded from the older rocks of the area. The terrace and alluvial deposits were not mapped on plate 1, however, they are described for some of the test wells in the report area. In deep test well DT-1, 35 feet of alluvium was penetrated.

Water supply.—Stream terrace and alluvial deposits along Limestone Creek and its tributaries are a source of ground water for limited domestic and stock use, however, these beds have not been developed as few families live in the lowland areas immediately adjacent to the streams.

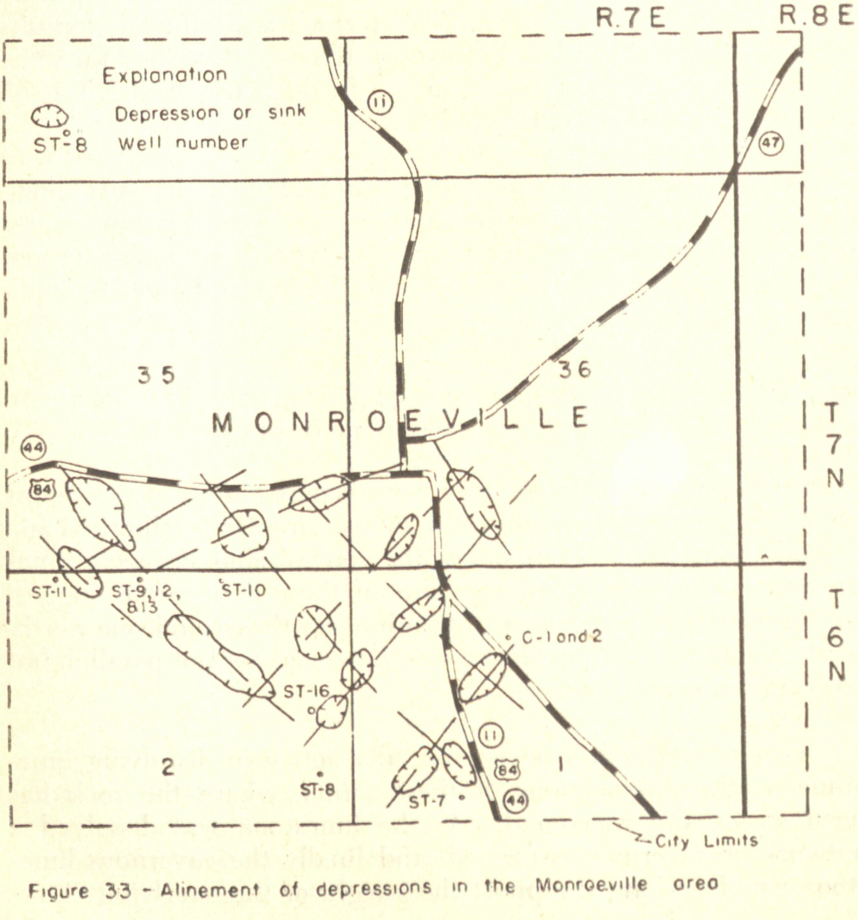
RELATION OF GEOLOGIC STRUCTURE TO OCCURRENCE OF GROUND WATER

Aerial photographs show numerous depressions in the report area. They vary in outline from almost circular to elliptical and extend about 35 to 40 feet below the general land surface. Lines drawn to connect the lowest points of these depressions suggest two sets of joint patterns, one trending northeast and one northwest (see fig. 33). The alinements, however, are not parallel, but converge in several places.

Ground water has been especially active in dissolving limestone at the intersections of these joints, where the rock has been structually weakened. As the limestone was dissolved a network of caverns was formed, and finally the cavernous limestone could no longer support the weight of the overlying Citronelle formation. The depressions found at the surface are expressions of the subsidence caused by caving of the limestone.

Test drilling in the border areas around the depressions indicated that the limestone was subjected to considerable groundwater action, which resulted in the formation of numerous cavities.

On the basis of this study, two conclusions have evolved concerning the relation of supposed joint structure to the occurrence of ground water. First, chances for developing wells in shallow limestones in the area are greater if drilling is done adjacent to the depressions shown in figure 33. Second, test drilling is necessary to locate these solution cavities and test pumping, to determine the quantity of water available.


R.7E
R.8E
Explanation
Depression or sink
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MONROEVILLE
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ST-9, 12, & 13
ST-10
C-1 and 2
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ST-8
ST-7
City Limits
T 7 N
T 6 N

Figure 33 - Alinement of depressions in the Monroeville area

SUMMARY

This report covers an area of 48 square miles in central Monroe County, Alabama. The area is predominately an upland surface that lies at an altitude of about 400 feet above mean sea level. Tertiary formations ranging in age from late Eocene to Recent crop out in the area and strike regionally northwest and dip southwest about 30 to 50 feet per mile. The structure in the area is normal except for minor faulting.

The sources of ground water at Monroeville are the sand beds in the basal part of the Nanafalia formation, in the basal part of the Tuscahoma sand, in the Lisbon formation and in the Gosport sand; from solution cavities in the Ocala, Marianna and Glendon limestones; and from sand and gravel beds of Miocene age and the Citronelle formation.

Shallow dug and drilled wells as much as 100 feet deep in the upland area at Monroeville develop water from deposits of Miocene age and the Citronelle formation. In general, these wells provide adequate water of good quality for domestic and stock use. Drilled wells as much as 150 feet deep that penetrate solution cavities in the Ocala, Marianna and Glendon limestones yield as much as 175 gpm. The water from these wells, although moderately hard, is low in dissolved solids and has been used for the Monroeville municipal supply for many years. Drilled wells ranging in depth from 150 to 475 feet, depending on topographic location, are developed in sand beds of the Lisbon formation and Gosport sand and yield as much as 140 gpm. The water from the Gosport and Lisbon usually is moderately hard, but otherwise is of satisfactory quality for most uses. Drilled wells ranging in depth from 1,000 to 1,500 feet penetrate water-bearing sand beds in the Tuscahoma sand and Nanafalia formation. Two municipal wells developed in these beds yield about 900 gpm each. The water from these wells is of good quality, although high in alkalinity and dissolved solids.

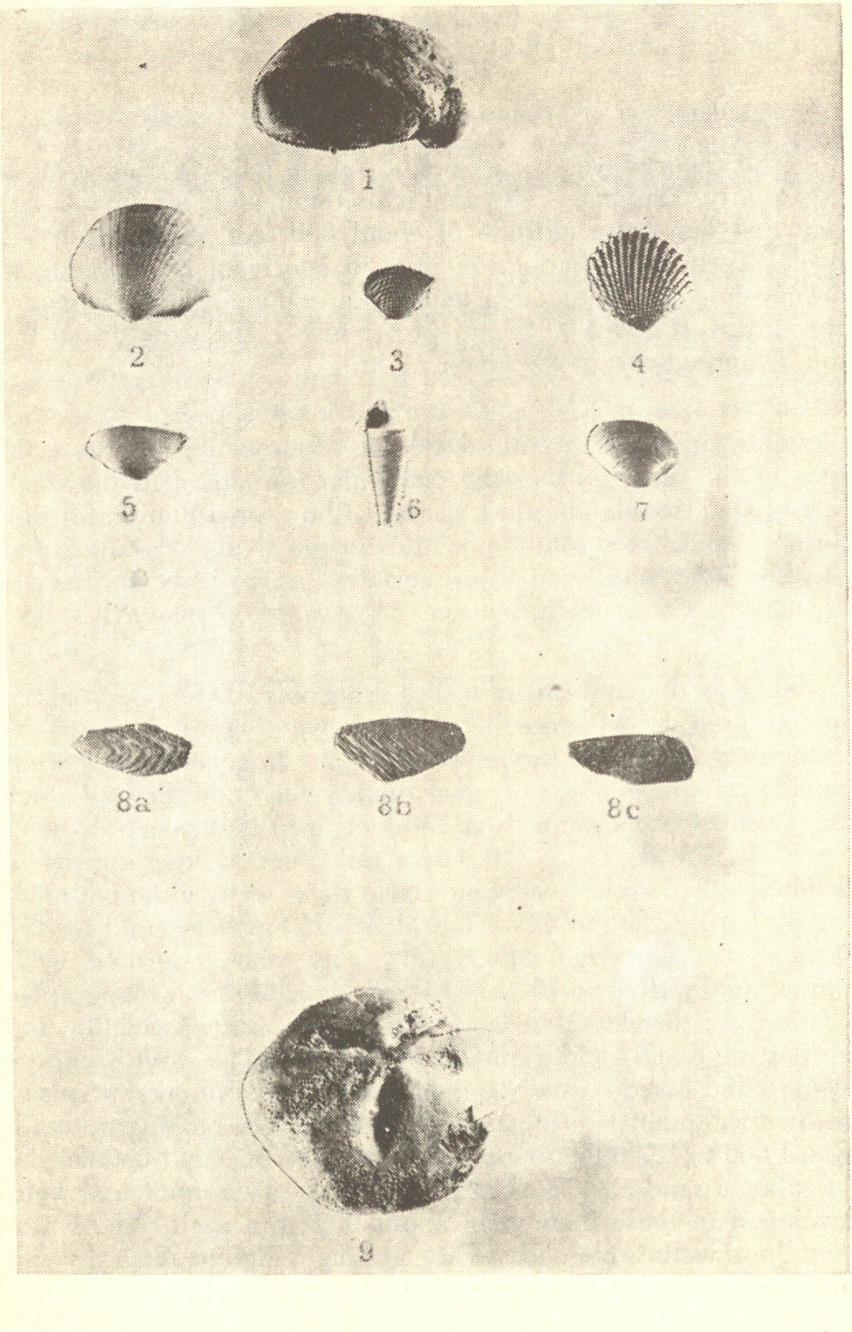
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Plate 7.—Fossils from the Gosport sand and Yazoo clay (restricted).

Plate 7.—Fossils from the Gosport sand and Yazoo clay (restricted)

Gosport sand:

(Outcrop in NE¼NW¼ sec. 30, T. 7 N., R. 8 E.)

1. *Crepidula lirata* Conrad, x0.77
2. *Glycymeris staminea* Conrad, x0.77
3. *Corbula murchisoni* Lea, x0.77
4. *Cardita rotunda* (Lea), x0.77
5. *Corbula murchisoni* Lea, x0.77
6. *Mesalia claibornensis* Harris, x0.77
7. *Callocardia lisbonensis* (Harris), x0.77

Yazoo clay (restricted):

(Outcrop in NE¼NE¼ sec. 25, T. 7 N., R. 7 E.)

8. Barnacle plates, x1.25

(Outcrop in NE¼SE¼ sec. 30, T. 7 N., R. 8 E.)

9. *Schizaster armiger* Clark, x1.0

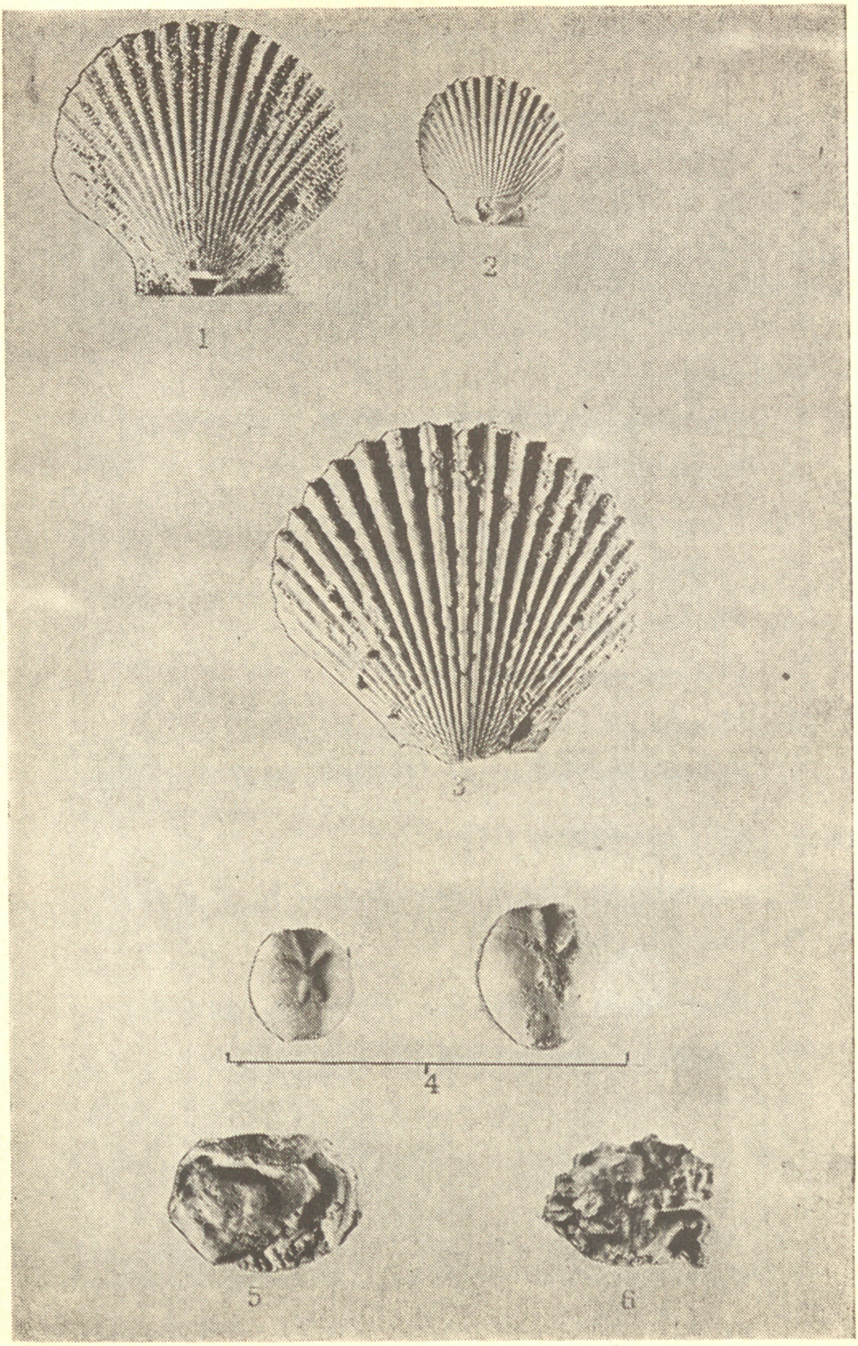

Plate 8.—Fossils from the Ocala limestone and Red Bluff clay (limestone facies).

Plate 8.—Fossils from the Ocala limestone and Red Bluff clay (limestone facies)

Ocala limestone:

(Outcrop in SE¼SW¼ sec. 10, T. 6 N, R. 8 E.)

1. *Chlamys spillmani* (Gabb), x1.25
2. *Chlamys spillmani* (Gabb), x1.25

(Outcrop in SW¼NW¼ sec. 30, T. 7 N., R. 8 E.)

3. *Chlamys centrotus* Dall, x1.25

(Outcrop in SE¼SE¼ sec. 25, T. 7 N., R. 7 E.)

4. *Brissopsis* sp. ch. B. *Steinhatchee* Cooke, x0.77

Red Bluff clay (limestone facies):

(Outcrop in SE¼SE¼ sec. 25, T. 7 N., R. 7 E.)

5. *Ostrea* sp. aff. *O. Vicksburgensis* Conrad, x0.77
6. *Ostrea* sp. aff. *O. Vicksburgensis* Conrad, x0.77

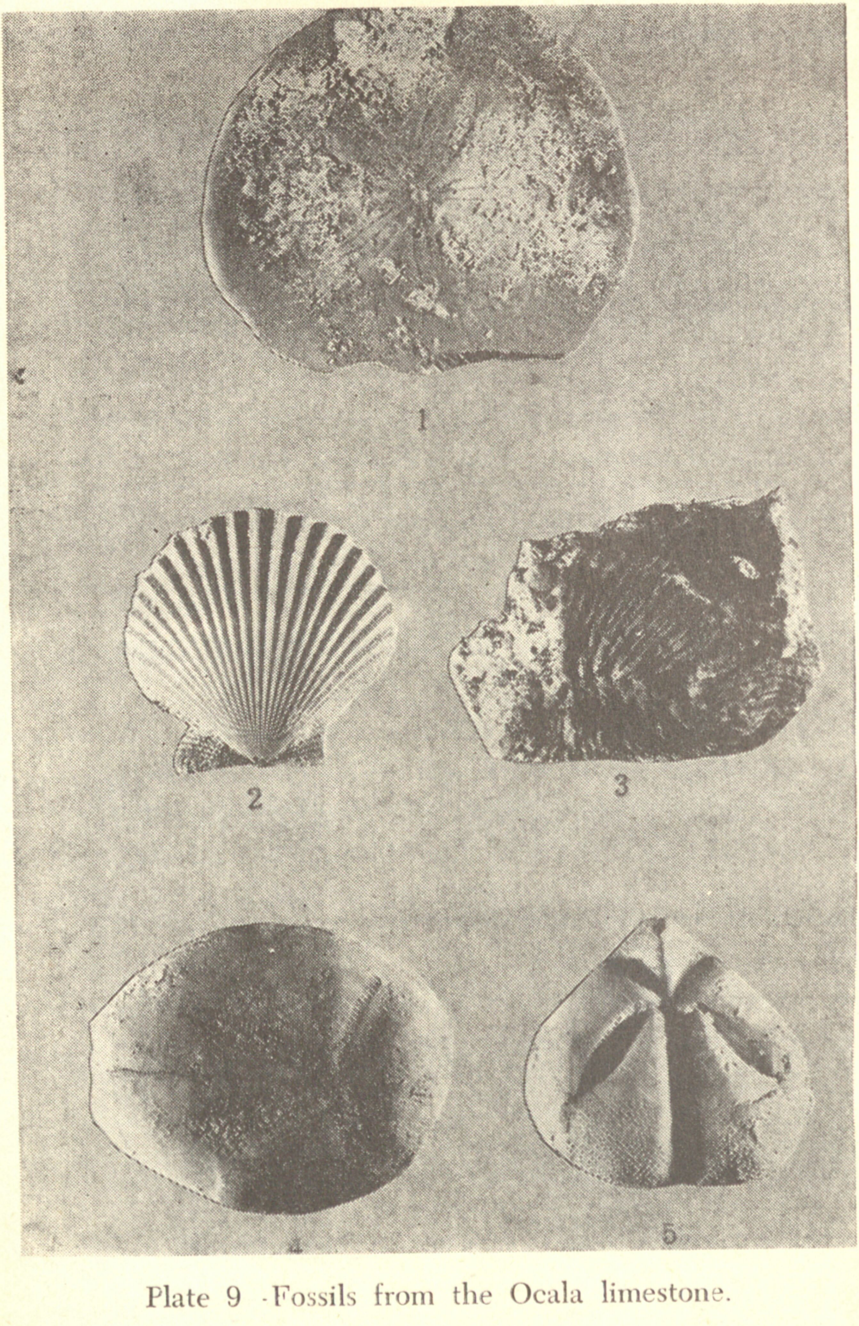

Plate 9 -Fossils from the Ocala limestone.

Plate 9.—Fossils from the Ocala limestone

Ocala limestone:

(Outcrop in NE¼NE¼ sec. 8, T. 6 N., R 8 E.)

1. *Periarchus lyelli pileus-sinensis* (Ravenel), x0.77

(Outcrop in SE¼NE¼ sec. 26, T. 7 N., R. 7 E.)

2. *Chlamys spillmani* (Gabb), x1.25

(Outcrop in SE¼NE¼ sec. 17, T. 6 N., R. 8 E.)

3. Coral (internal mold), x0.93

(Outcrop in NE¼NW¼ sec. 8, T. 6 N., R. 8 E.)

4. *Eupatagus* (*Plagiobrissus*) *ocalanus* Cooke, x0.93

(Outcrop in SW¼ sec 31, T. 7 N., R. 8 E.)

5. *Schizaster armiger* Clarke, x0.93

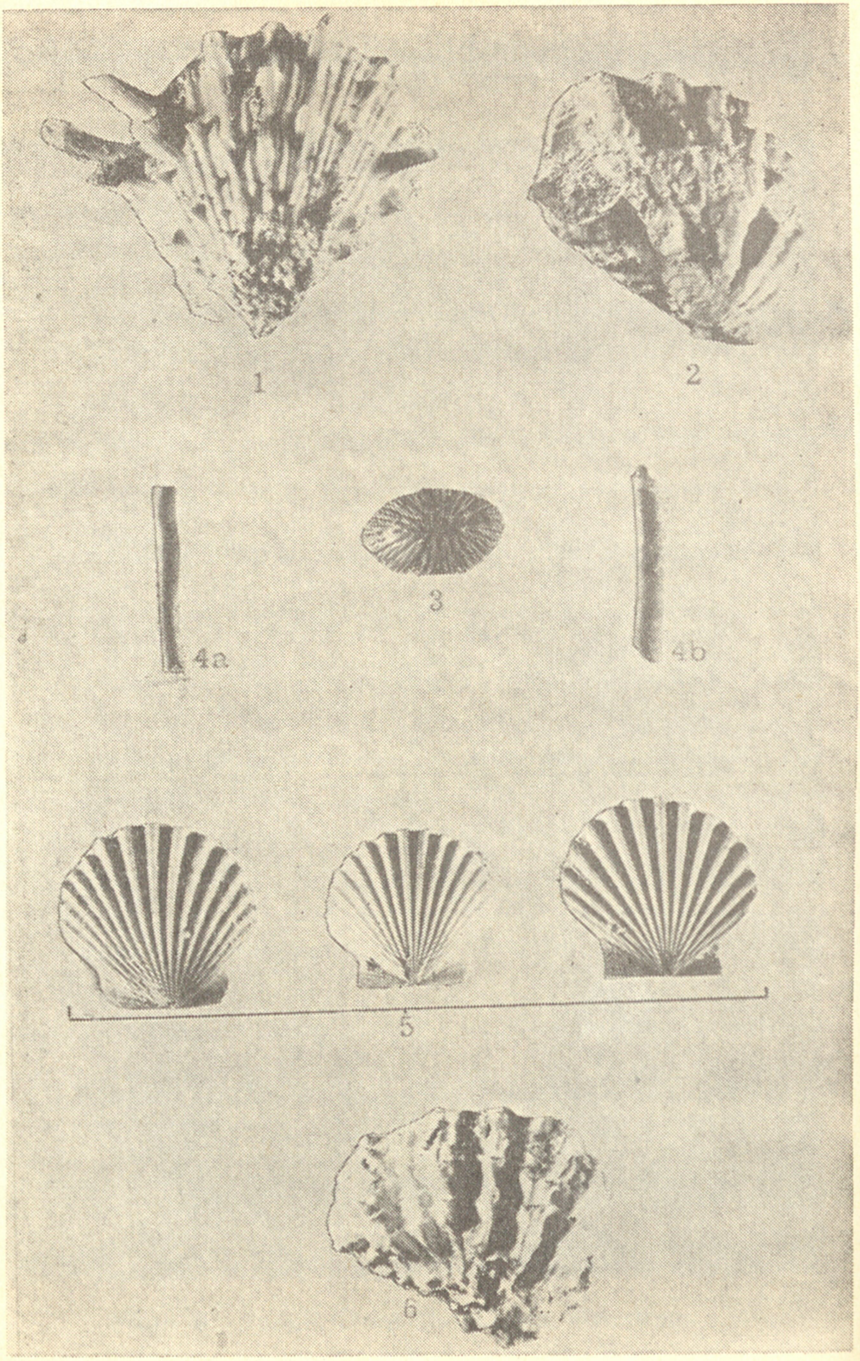

Plate 10.—Fossils from the Red Bluff clay (limestone facies) and Marianna limestone.

Plate 10.—Fossils from the Red Bluff clay (limestone facies) and Marianna limestone

Red Bluff clay (limestone facies):

(Outcrop in NW¼NE¼ sec. 6, T. 6 N., R. 8 E.)

1. *Spondylus dumosus* (Morton), x1.25

(Outcrop in SE¼NE¼ sec. 26, T. 7 N., R. 7 E.)

2. *Ostrea vicksburgensis* Conrad, x1.25
3. Coral (internal mold), x1.25
4. Worm tubes, x1.25

Marianna limestone:

(Outcrop in NW¼SW¼ sec. 2, T. 6 N., R. 7 E.)

5. *Pecten poulsoni* Morton, x0.93
6. *Ostrea vicksburgensis* Conrad, x0.93

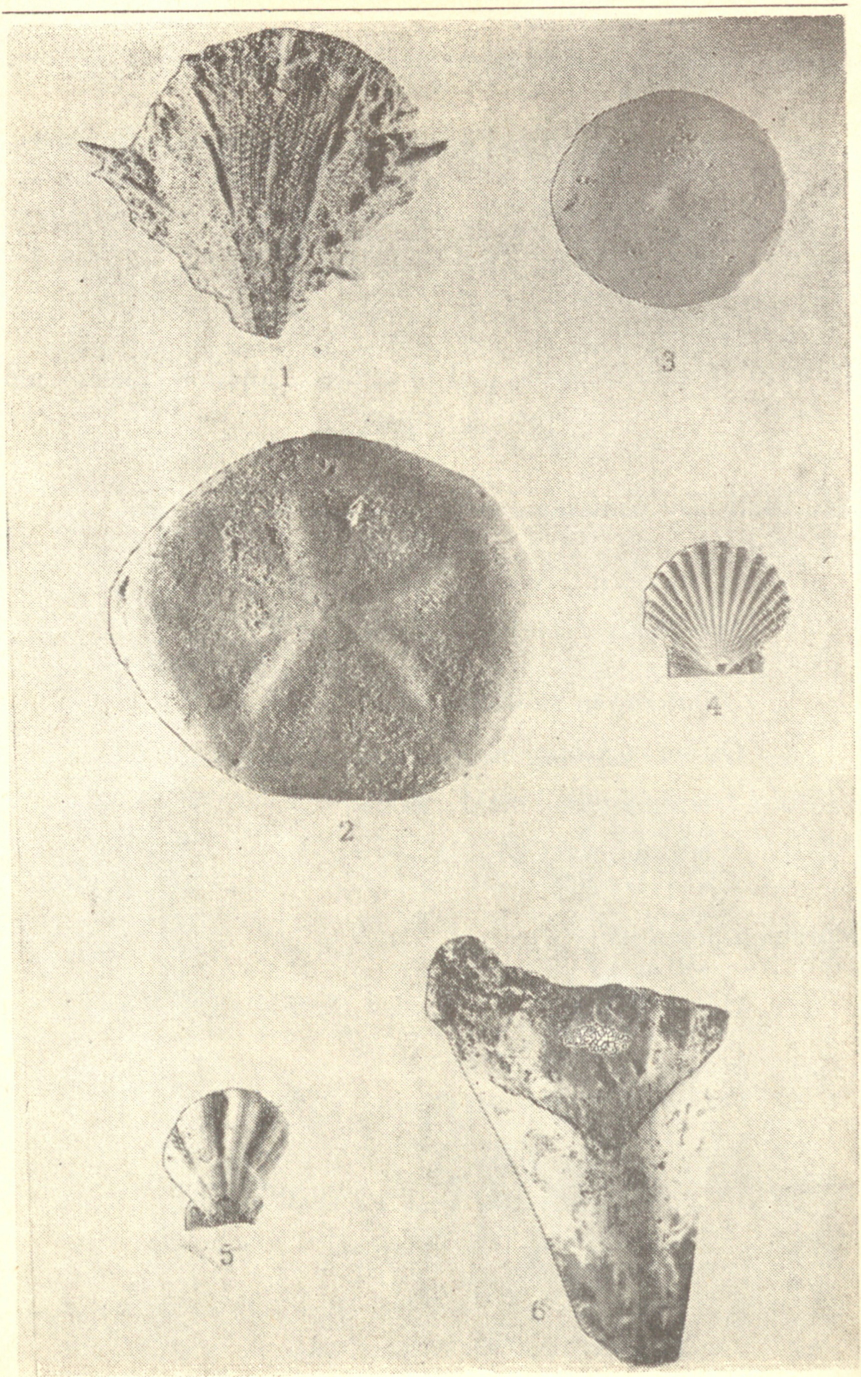

Plate 11.--Fossils from the Marianna limestone and Byram formation

Plate 11. – Fossils from the Marianna limestone and Byram formation

Marianna limestone:

(Outcrop in NW¼SW¼ sec. 2, T. 6 N., R. 7 E.)

1. *Spondylus* n. sp., x1.25

(Outcrop in NW¼SE¼ sec. 4, T. 6 N., R. 7 E.)

2. *Clypeaster rogersi* (Morton), x1.0

(Outcrop in SE¼SE¼ sec. 15, T. 6 N., R. 6 E.)

3. *Lepidocyclina mantelli* (Morton), x1.25
4. *Pecten poulsoni* Morton, x1.25

Byram formation

Glendon limestone member:

(Outcrop in SE¼SE¼ sec. 15, T. 6 N., R. 6 E.)

5. *Chlamys anatipes* (Morton), x0.93
6. Carcharodon, x0.93

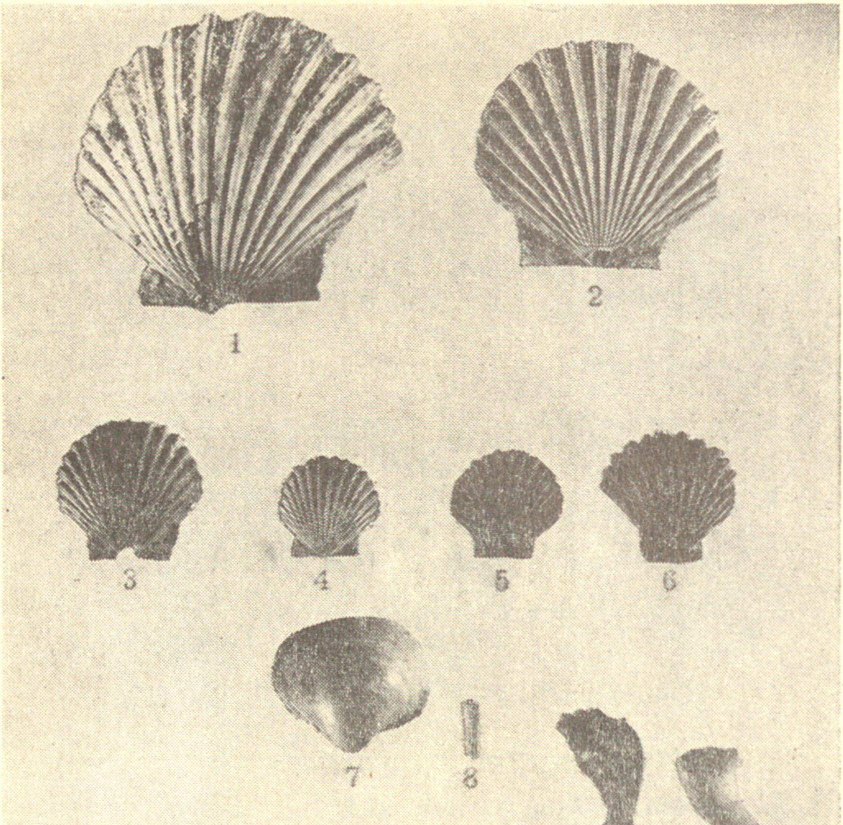
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Plate 12.—Fossils from the Byram formation.

Plate 12.—Fossils from the Byram formation

Byram formation

Marl member:

(Outcrop in SE¼SE¼ sec. 15, T. 6 N., R. 6 E.)

1. *Pecten byramensis* Gardner, x1.25
2. *Pecten byramensis* Gardner, x1.25

Bucatunna clay member:

(Outcrop in SW¼SE¼ sec. 4, T. 6 N., R. 7 E.)

3. *Anadara mississippiensis* (Conrad), x0.77
4. *Pecten byramensis* Gardner, x0.77
5. *Anadara mississippiensis* (Conrad), x0.77
6. *Pecten byramensis* Gardner, x0.77
7. *Nemocardium diversum* (Conrad), x0.77
8. *Dentalium mississippiensis* Conrad, x0.77
9. *Balanophyllia* aff. *B. caulifera* (Conrad), x0.77

(Outcrop in NE¼NE¼ sec. 9, T. 6 N., R. 7 E.)

10. *Anadara mississippiensis* (Conrad), x1.25
11. *Andara mississippiensis* (Conrad), x1.25
12. *Anadara mississippiensis* (Conrad), x1.25
13. *Pecten byramensis* Gardner, x1.25
14. *Pecten byramensis* Gardner, x1.25
15. *Ostrea vicksburgensis* Conrad, x1.25

SELECTED BIBLIOGRAPHY

Brewer, Willis, 1872, Alabama: Her history, resources, war record, and public men: Bassett & Brown, Montgomery, Ala.

Casey, T. L., 1901, On the probable age of the Alabama white limestone: Phila. Acad. Nat. Sci. Proc., v. 53., p. 513-518.

Cooke, C. W., 1918, Correlation of the deposits of Vicksburg and Jackson age in Alabama and Mississippi: Wash. Acad. Sci. Jour., v. 8, no. 7, p. 186-198.

——————, 1926, The Cenozoic formations, *in* Adams, G. I., et al., Geology of Alabama: Ala. Geol. Survey Special Rept. 14, p. 251-297.

Cooke, C. W., Gardner, Julia, and Woodring, W. P., 1943, Correlation of the Cenozoic formations of the Gulf Coastal Plain and the Caribbean region: Geol. Soc. America Bull, v. 54, (chart at end of report).

Dall, W. H., et al., 1898, A table of North American Tertiary horizons, correlated with one another and with those of western Europe, with annotations: U. S. Geol. Survey 18th Ann. Rept., pt. 2-C, p 323-348.

Hambidge, Gove (Editor), et al., 1941, Climate and Man, U. S. Dept. Agriculture Yearbook.

Hilgard, E. W., 1860, Report on the geology and agriculture of the State of Mississippi: 391 p., map. Jackson, Miss.

Hopkins, O. B., 1917, Oil and gas possibilities of the Hatchetigbee anticline, Alabama: U. S. Geol. Survey Bull. 661-H, p. 281-313, pls. 26-29.

LaMoreaux, P. E., 1948, Fluoride in the ground water of the Tertiary area of Alabama: Ala. Geol. Survey Bull. 59.

Lowe, E. N., 1915, Mississippi, its geology, geography, soils, and mineral resources: Mississippi Geol. Survey Bull. 12, 335 p., map.

Matson, G. C., and Berry, E. W., 1916, the Pliocene Citronelle formation of the Gulf Coastal Plain, p. 167-192; The flora of the Citronelle formation, p. 193-208: U. S. Geol. Survey Prof. Paper 98-L.

MacNeil, F. S., 1944, Oligocene stratigraphy of southeastern United States: Am. Assoc. Petroleum Geologists Bull., v. 28, no. 9, p. 1313-1354.

———, 1946a, Geologic map of the Tertiary formations of Alabama: U. S. Geol. Survey Oil and Gas Inv. Prelim. Map 45.

———, 1946b, The Tertiary formations of Alabama: SE. Geol. Soc. Guidebook, 4th Field Trip, 91 p.

———, 1947, Correlation chart for the outcropping Tertiary formations of the eastern Gulf Coastal Plain: U. S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29.

Meinzer, O. E., 1923, Outline of ground-water hydrology, with definitions: U. S. Geol. Survey Water-Supply Paper 494, 71 p.

Owen, Thomas M., 1921, History of Alabama and dictionary of Alabama biography: S. J. Clark Publishing Co., Chicago, Ill.

Stenzel, H. B., 1952, Jackson-Claiborne section exposed at highway bridge at Claiborne: Miss. Geol. Soc. Guidebook, 9th Field Trip.

Toulmin, L. D., LaMoreaux, P. E., and Lanphere, C. R., 1951, Geology and ground-water resources of Choctaw County, Ala.: Ala. Geol. Survey Special Rept. 21; County Rept. 2.

Table 1.--Records of wells in the Monroeville area, Alabama

Well no.: Numbers correspond to those in plate 2 and table 2; asterisk indicates chemical analysis given in table 2.
Type of well: B, bored; D, drilled; Dr, driven.
Depth of well: Depths shown in feet are reported; those in feet and tenths are measured.
Type of casing: S, steel; T, tile or concrete; W, wood curbing.
Method of lift: C, cylinder; J, jet; M, manual; P, pitcher; T, turbine.
Use: D, domestic; I, industrial; N, none; Obs, observation; PS, public supply; S, stock; T, test.

Water level: MP, measuring point.
Water-bearing formations: En, Nanafalia formation; Etu-En, Tuscahoma sand and Nanafalia formation undifferentiated; Et, Tallahatta formation; Egl, Gosport sand and Lisbon formation undifferentiated; Eo, Ocala limestone; Omrb, Marianna limestone and Red Bluff clay (limestone facies) undifferentiated; Obmg, Glendon limestone and marl members of Byram formation; Pc, Citronelle formation.

Well no.	Location	Owner	Type of well	Depth of well (ft.)	Diameter of casing (in.)	Depth of casing (ft.)	Type of casing	Principal water-bearing formation	Water level: Elevation of MP (ft.)	Water level: Water level below (-) MP (ft.)	Date of measurement	Method of lift	Use	Remarks
C -1	NE¼NW¼ sec. 1, T. 6 N., R. 7 E.	City of Monroeville	D	107	12	--	S	Omrb	420	--	--	T	PS	Known as Gray well no. 1. Yield about 175 gpm in spring 1952.
C -2	do.	do.	D	158	12	76	S	Omrb	420	65.0	Aug. 24, 1951	T	PS	Known as Gray well no. 2. Yield about 130 gpm in spring 1952.
C -3	SE¼NE¼ sec. 2, T. 6 N., R. 7 E.	do.	D	475	24	97	S	Egl	410	--	--	T	PS	Known as Layne well. Yield about 75 gpm in spring 1952.
*C -4	NE¼SW¼ sec. 1, T. 6 N., R. 7 E.	do.	D	438	12	280	S	Egl	401	--	--	T	PS	Known as Peerson well. Yield about 140 gpm in spring 1952.
*DT-1	NW¼SE¼ sec. 3, T. 6 N., R. 7 E.	do.	D	147.0	6	43	S	Egl	213	18.8	Oct. 3, 1951	--	T	Tested interval 101-147 feet. Measured drawdown 5.8 feet while pumping 12 gpm on Oct. 4, 1951.
*DT-1	do.	do.	D	1,160.0	6	43	S	Etu-En	213	29.2	Nov. 12, 1951	--	T	Tested interval 1,065-1,160 feet. Measured drawdown 28.5 feet after pumping 15 gpm for 36 hours on Nov. 1 1951.
*DT-1	do.	do.	D	1,233.0	6	43	S	En	213	47.0	Nov. 20, 1951	--	T	Tested interval 1,165-1,213 feet. Measured drawdown 9.6 feet after pumping 27.5 gpm for 2 hours on Nov. 20, 1951.
ST-1	NE¼NW¼ sec. 11, T. 6 N., R. 7 E.	U. S. Geol. Survey	D	275.0	4	80	S	Egl	365	--	--	--	T	Electric log in files of U. S. Geol. Survey.
ST-2	NE¼SW¼ sec. 11, T. 6 N., R. 7 E.	do.	D	250.0	4	151	S	Egl	358	38.0	Jan. 12, 1952	--	T	Do.
ST-3	SW¼SW¼ sec. 6, T. 6 N., R. 8 E.	do.	D	293.0	4	150	S	Egl	409	55.0	Feb. 13, 1952	--	T	Do.
ST-4	NW¼NW¼ sec. 7, T. 6 N., R. 8 E.	do.	D	120.0	4	72	S	Obmg	418	58.2	Jan. 29, 1952	--	T	Do.
ST-5	NW¼SE¼ sec. 12, T. 6 N., R. 7 E.	do.	D	310.0	4	170	S	Egl	339	44.0	Jan. 30, 1952	--	T	Do.
ST-6	SE¼SE¼ sec. 1, T. 6 N., R. 7 E.	do.	D	130.0	4	88	S	Obmg	428	65.0	Jan. 23, 1952	--	T	Do.
ST-7	NE¼SW¼ sec. 1, T. 6 N., R. 7 E.	do.	D	320.0	4	110	S	Egl	418	67.7	Feb. 8, 1952	--	T	Do.
ST-8	SE¼NE¼ sec. 2, T. 6 N., R. 7 E.	do.	D	150.0	4	--	--	--	424	--	--	--	T	Dry. No solution cavities penetrated. Electric log in files of U. S. Geol. Survey.
*ST-9	NE¼NW¼ sec. 2, T. 6 N., R. 7 E.	do.	D	160.0	4	80	S	Omrb	409	65.1	Feb. 26, 1952	--	T	Test-pumped with submersible pump.
ST-10	NW¼NE¼ sec. 2, T. 6 N., R. 7 E.	do.	D	280.0	4	101	S	Egl	407	60.0	Feb. 15, 1952	--	T	Electric log in files of U. S. Geol. Survey.
ST-11	NE¼NW¼ sec. 2, T. 6 N., R. 7 E.	do.	D	160.0	4	100	S	Omrb	398	65.2	Feb. 26, 1952	--	T	Do.
		do.	D	170.0	6	88	S	--	409	--	--	--	T	Dry. No solution cavities penetrated.

Table 1.--Records of wells in the Monroeville area, Ala.--Continued

Well no.	Location	Owner	Type of well	Depth of well (ft.)	Diameter of casing (in.)	Depth of casing (ft.)	Type of casing	Principal water-bearing formation	Water level		Date of measurement	Method of lift	Use	Remarks
									Elevation of MP (ft.)	Water level below (-) MP (ft.)				
ST-13	NE¼NW¼ sec. 2, T. 6 N., R. 7 E.	U. S. Geol. Survey	D	140.0	6	88	S	Omrb	409	65.4	June 18, 1952	--	Obs	Measured drawdown 45 feet after pumping 102 gpm for 6 hours on May 31, 1952. Pumped test well; now used as observation well.
ST-14	NE¼NW¼ sec. 1, T. 6 N., R. 7 E.	do.	D	72.0	4	72	S	Pc	418	65.0	June 20, 1952	--	T	Former observation well. Electric log in files of U. S. Geol. Survey.
ST-15	SE¼NE¼ sec. 25, T. 7 N., R. 7 E.	do.	D	210.0	4	62	S	Egl	372	55.0	June 25, 1952	--	T	Electric log in files of U.S. Geol. Survey.
ST-16	NE¼NE¼ sec. 2, T. 6 N., R. 7 E.	do.	D	140.0	--	--	--	--	407	--	--	--	T	Dry. No solution cavities penetrated.
* 1	SE¼SE¼ sec. 4, T. 6 N., R. 7 E.	Francis Johnson	D	148	2	71	S	Eo	348	--	--	C	D	
2	SW¼SW¼ sec. 9, T. 6 N., R. 7 E.	Minniebelle Simpkins	B	19.0	9	19	W	Pc	415±	18.2	Apr. 9, 1953	M	D	
3	do.	Ethel Parker	B	14.6	9	14.6	W	Pc	415±	14.0	do.	M	D,S	
4	NW¼SW¼ sec. 9, T. 6 N., R. 7 E.	John Salter	B	24.5	9	24.5	W	Pc	415±	20.0	do.	M	D,S	
5	NE¼NW¼ sec. 9, T. 6 N., R. 7 E.	William Lee	B	60	2	35	S	Pc	--	--	--	P	D	
6	SW¼NE¼ sec. 9, T. 6 N., R. 7 E.	Joe M. Turberville	B	45.0	9	45.0	W	Pc	415±	39.8	Apr. 9, 1953	M	D	
7	SW¼NE¼ sec. 9, T. 6 N., R. 7 E.	do.	B	48.8	9	48.8	W	Pc	415±	40.3	do.	M	D,S	
8	NW¼NE¼ sec. 9, T. 6 N., R. 7 E.	C. M. Wiggins	B	39.2	9	39.2	W	Pc	415±	31.0	do.	M	D,S	
9	NW¼NW¼ sec. 16, T. 6 N., R. 7 E.	Sam D. Simmons	B	31	12	31	T	Pc	--	--	--	J	D,S	
10	SE¼NW¼ sec. 16, T. 6 N., R. 7 E.	S. T. Lambert	Dr	30	2	30	S	Pc	--	--	--	C	D	
11	SW¼NE¼ sec. 16, T. 6 N., R. 7 E.	T. F. Bouler	B	26	1½	26	S	Pc	--	--	--	C	D,S	
12	SE¼SW¼ sec. 16, T. 6 N., R. 7 E.	St. Louis & San Francisco RR	D	170	10	170	S	Pc	407	--	--	C	I	Supplies railroad.
13	SW¼SW¼ sec. 16, T. 6 N., R. 7 E.	Brannon-Hayes Veneer Co.	D	85	4	60	S	Pc	--	--	--	J	I	
14	SE¼SW¼ sec. 10, T. 6 N., R. 7 E.	W. D. Rawls	B	28	3/4	22	S	Pc	--	--	--	C	D,S	
15	NE¼NE¼ sec. 11, T. 6 N., R. 7 E.	Otie Lee Daniels	D	80	1½	--	S	Pc	--	--	--	J	D,S	
16	SW¼SW¼ sec. 1, T. 6 N., R. 7 E.	Tom Parker	B	50.0	9	50	W	Pc	410±	--	--	M	D	Dry.
17	do.	Roosevelt Parker	B	60	9	60	W	Pc	405±	--	--	M	N	Covered.
18	HE¼SE¼ sec. 16, T. 6 N., R. 7 E.	J. A. Hatter	D	40	2	40	S	Pc	--	--	--	--	D	
19	SW¼SW¼ sec. 15, T. 6 N., R. 7 E.	J. P. Bell	B	26	1½	25	S	Pc	--	--	--	C	D,S	

Table 1.--Records of wells in the Monroeville area, Ala.--Continued

Well no.	Location	Owner	Type of well	Depth of well (ft.)	Diameter of casing (in.)	Depth of casing (ft.)	Type of casing	Principal water-bearing formation	Water level		Date of measurement	Method of lift	Use	Remarks
									Elevation of MP (ft.)	Water level below (-) MP (ft.)				
*20	NE¼NW¼ sec. 23, T. 6 N., R. 7 E.	M. B. Petty	D	204	4	200	S	Obmg-Omrb	426	--	--	C	D	
21	NE¼SE¼ sec. 14, T. 6 N., R. 7 E.	Hugh Dickson	D	490	2	100	S	Egl?	431	--	--	T	D	
22	SE¼NW¼ sec. 13, T. 6 N., R. 7 E.	Charles Floyd	D	100	2	63	S	Pc	--	--	--	J	D,S	
23	SW¼SW¼ sec. 13, T. 6 N., R. 7 E.	State Experimental Farm	D	66	4	--	S	Pc	--	--	--	C	D,S	
24	SW¼SE¼ sec. 12, T. 6 N., R. 7 E.	Mrs. C. L. Hybert	D	--	4	--	S	Pc?	--	--	--	C	D	
25	SE¼NW¼ sec. 12, T. 6 N., R. 7 E.	B. H. Stallworth	D	160	--	--	S	Obmg-Omrb	407	--	--	C	D,S	
26	SE¼NW¼ sec. 17, T. 6 N., R. 8 E.	George Finklea	B	47	2	44	S	Pc	--	--	--	C	D,S	
27	SE¼NW¼ sec. 8, T. 6 N., R. 8 E.	Willie Lee Johnson	B	60	9	60	W	Pc	--	--	--	M	D	
*28	SE¼SW¼ sec. 7, T. 6 N., R. 8 E.	T. A. Emmons	B	62	1½	57	S	Pc	403±	--	--	C	D,S	
*29	SW¼SE¼ sec. 7, T. 6 N., R. 8 E.	J. F. Jackson	D	105	4	105	S	Pc	388	--	--	J	S	
*30	SE¼NW¼ sec. 7, T. 6 N., R. 8 E.	H. R. Carter	D	105	4	105	S	Obmg	409	--	--	C	D	
31	NE¼SE¼ sec. 7, T. 6 N., R. 8 E.	Jennings Carter	D	222	4	105	S	Obmg-Omrb	340	--	--	C	D,S	
32	NE¼NW¼ sec. 7, T. 6 N., R. 8 E.	Hybert Manning	D	100	4	84	S	Obmg	427	--	--	C	D	
*33	do.	Fred Sheffield	D	100	4	--	S	Obmg	437	--	--	C	D,S	
34	NW¼NW¼ sec. 7, T. 6 N., R. 8 E.	R. E. Ivey	D	100+	2	90	S	Obmg	--	--	--	C	D,S	
35	SE¼SE¼ sec. 1, T. 6 N., R. 7 E.	Monroe Lumber Co.	B	85	4	85	S	Pc	--	--	--	C	I	
*36	do.	do.	B	95	6	95	S	Pc	--	--	--	C	I	
37	NE¼SW¼ sec. 6, T. 6 N., R. 8 E.	Prince Preyer	D	69	4	69	S	Pc	--	--	--	C	D,S	
38	do.	Howard Faulk	B	32.0	9	32.0	W	Pc	400±	32.0	Apr. 9, 1953	M	D	
39	SE¼NE¼ sec. 6, T. 6 N., R. 8 E.	do.	B	40.7	9	40.7	W	Pc	355±	34.0	do.	M	D	
40	NE¼SE¼ sec. 6, T. 6 N., R. 8 E.	do.	Dug	25.5	--	--	--	Pc	345±	20.8	do.	M	D	
41	SE¼NW¼ sec. 5, T. 6 N., R. 8 E.	Willie J. Royster	Dug	40.9	30	16+	W	Pc	330±	36.8	do.	M	D,S	
42	NE¼NW¼ sec. 5, T. 6 N., R. 7 E.	Frank Abney	Dug	38.3	30	--	--	Pc	325±	31.6	do.	M	D,S	
43	SE¼NW¼ sec. 32, T. 7 N., R. 8 E.	Clarence L. Lett	Dug	29.5	--	29.5	--	Pc	300±	25.1	do.	M	D,S	

Table 1.--Records of wells in the Monroeville area, Ala.--Continued

Well no.	Location	Owner	Type of well	Depth of well (ft.)	Diameter of casing (in.)	Depth of casing (ft.)	Type of casing	Principal water-bearing formation	Water level		Date of measurement	Method of lift	Use	Remarks
									Elevation of MP (ft.)	Water level below (-) MP (ft.)				
44	NW¼SW¼ sec. 5, T. 6 N., R. 8 E.	Howard Faulk	B	63.2	6	--	S	Pc	350±	47.0	Apr. 9, 1953	M	D,S	
45	NW¼NE¼ sec. 5, T. 6 N., R. 8 E.	William Abney	B	46.8	9	46.8	W	Pc	310±	41.1	do.	M	D,S	
46	NE¼NE¼ sec. 31, T. 7 N., R. 8 E.	Willie Durden	Dug	29.8	--	--	--	Pc	345±	23.3	do.	M	D	
47	NW¼SW¼ sec. 31, T. 7 N., R. 8 E.	Mrs. S. W. Westbrook	B	80	4	--	S	Pc	--	--	--	J	D	
48	SW¼SW¼ sec. 30, T. 7 N., R. 8 E.	H. G. Gulsby	D	85	6	85	S	Pc	--	--	--	J	D	
49	SW¼SE¼ sec. 20, T. 7 N., R. 8 E.	Beatrice Veneer Mill	D	110	4	--	S	Et?	160	--	--	C	D	
50	NE¼NW¼ sec. 21, T. 7 N., R. 8 E.	do.	D	390	3	88	S	Et	268	--	--	C	D	
51	NE¼NW¼ sec. 29, T. 7 N., R. 8 E.	do.	D	120	4	115	S	Et	280	--	--	--	D	
52	NE¼SW¼ sec. 6, T. 6 N., R. 8 E.	Howard Faulk	Dr	140	3	140	S	Omrb?	--	--	--	C	D	
53	NW¼SE¼ sec. 6, T. 6 N., R. 8 E.	do.	B	32.5	9	32.5	W	Pc	380±	27.6	Apr. 9, 1953	M	D	
54	SW¼NW¼ sec. 6, T. 6 N., R. 8 E.	Charlie Henson	B	30	9	--	W	Pc	--	--	--	M	D,S	
55	NW¼SW¼ sec. 6, T. 6 N., R. 8 E.	Booker T. Bivins	B	26.3	9	26.3	W	Pc	375±	26.3	Apr. 9, 1953	M	D	
56	NW¼NW¼ sec. 7, T. 6 N., R. 8 E.	Raymond Owen	D	110	4	91	S	Obmg	425±	66.4	Apr. 29, 1952	C	D	
57	NE¼SE¼ sec. 1, T. 6 N., R. 7 E.	M. Carey	B	44.3	9	44.3	W	Pc	405±	44.3	Apr. 9, 1953	M	D	
58	SW¼NE¼ sec. 1, T. 6 N., R. 7 E.	Willie Scott	B	--	9	--	W	Pc	425±	--	--	--	N	Dry
59	NW¼NW¼ sec. 6, T. 6 N., R. 8 E.	Jim Gulley	B	24.5	9	24.5	W	Pc	395±	22.4	Apr. 9, 1953	--	N	
60	do.	Jim Stallworth	B	48.6	9	48.6	W	Pc	430±	44.6	do.	M	D,S	
61	do.	Charles Madison	B	50.1	9	50.1	W	Pc	415±	44.4	do.	M	D,S	
62	SW¼NE¼ sec. 1, T. 6 N., R. 7 E.	Anna Woodin	B	63.0	9	63.0	W	Pc	435±	58.7	do.	M	D,S	
63	SW¼SE¼ sec. 35, T. 7 N., R. 7 E.	J. H. Frye	B	79	9	79	W	Pc	--	--	--	M	D	
64	SE¼SE¼ sec. 34, T. 7 N., R. 7 E.	Frank Parker	B	75.0	9	75	W	Pc	390±	73.1	Apr. 9, 1953	M	D,S	
65	SW¼SE¼ sec. 34, T. 7 N., R. 7 E.	William Clausell, Jr.	D	90	3	90	S	Pc	--	--	--	C	D,S	Supplies water for 5 families.
66	SW¼SW¼ sec. 34, T. 7 N., R. 7 E.	Edgar Crow	B	50	9	50	W	Pc	360±	42.8	Apr. 9, 1953	M	D	Supplies water for 2 families.

Table 1.--Records of wells in the Monroeville area, Ala.--Continued

Well no.	Location	Owner	Type of well	Depth of well (ft.)	Diameter of casing (in.)	Depth of casing (ft.)	Type of casing	Principal water-bearing formation	Water level		Date of measurement	Method of lift	Use	Remarks
									Elevation of MP (ft.)	Water level below (-) MP (ft.)				
67	NW¼NW¼ sec. 2, T. 6 N., R. 7 E.	Ed McMillan	B	60.0	9	60	W	Pc	330±	59.8	Apr. 9,1953	M	D,S	
68	SE¼NE¼ sec. 34, T. 7 N., R. 7 E.	Arthur McLaughlin	B	45	9	45	W	Pc	350±	--	--	J	D,S	Supplies water for 2 families
69	do.	Willie Nettles	B	34.5	9	34.5	W	Pc	355±	25.6	Apr. 9,1953	M	D,S	
70	do.	Fred Clausell	B	41.0	9	41.0	W	Pc	350±	25.7	do.	M	D,S	
71	SW¼NE¼ sec. 34, T. 7 N., R. 7 E.	John Nettles	B	45	9	--	W	Pc	--	--	--	J	D	
72	NW¼NE¼ sec. 34, T. 7 N., R. 7 E.	Arthur Clausell	B	41.5	9	41.5	W	Omrb?	370±	34.8	Apr. 9,1953	M	D,S	
73	do.	Nelson Clausell	B	51.5	9	51.5	W	Omrb?	360±	38.5	do.	M	D	
74	NE¼NE¼ sec. 34, T. 7 N., R. 7 E.	Earl Royster	B	71.0	9	71	W	Pc	380±	65.8	do.	M	D	
75	do.	Robert Clausell	B	42	1-3/4	42	S	Pc	--	--	--	J	D	
76	NW¼NE¼ sec. 34, T. 7 N., R. 7 E.	Walter Odom	B	62.2	9	62.2	W	Pc	375±	57.6	Apr. 9,1953	M	D,S	
*77	NE¼NW¼ sec. 34, T. 7 N., R. 7 E.	Bethlehem Industrial School	D	260	4	100	S	Egl	380	--	--	C	PS	
*78	NE¼NW¼ sec. 27, T. 7 N., R. 7 E.	Van Whiting	D	300	4	130	S	Egl	410	--	--	C	D,S	
79	NW¼NW¼ sec. 16, T. 6 N., R. 7 E.	Peter James	B	21.0	9	17	W	Pc	415±	10.3	Apr. 9,1953	M	D	
80	SW¼SW¼ sec. 9, T. 6 N., R. 7 E.	Luman James	B	30	3	--	S	Pc	--	--	--	J	D	
81	SE¼NE¼ sec. 8, T. 6 N., R. 7 E.	Charles Wiggins	B	--	9	--	W	Pc	--	--	--	C	D	
*82	SW¼SW¼ sec. 2, T. 6 N., R. 7 E.	Vanity Fair Mills	D	430	4	--	--	Egl	367	--	--	T	D	
83	SW¼SW¼ sec. 30, T. 7 N., R. 8 E.	Charles Floyd	D	130	4	85	S	Eo	377	--	--	C	D	
*84	do.	Robison Harper	D	140	4	--	S	Omrb?	372	--	--	C	D,S	
85	SE¼NE¼ sec. 26, T. 7 N., R. 7 E.	Lucy Davis	D	97	1-3/4	--	S	Omrb	347	--	--	J	D	
*86	SW¼SW¼ sec. 36, T. 7 N., R. 7 E.	Charlie Stevens	D	250	4	75	S	Egl	387	52.0	Oct. 9,1951	T	D	
87	NW¼NW¼ sec. 33, T. 7 N., R. 8 E.	Henry McPherson	B	16	9	--	W	Pc	195±	--	--	--	--	Dry; plugged
88	NW¼NW¼ sec. 33, T. 7 N., R. 8 E.	Joe Howard Brantley	B	16.8	9	16.8	W	Pc	185±	12.4	Apr. 9,1953	M	D	
89	do.	do.	B	13.9	9	13.9	W	Pc	185±	9.3	do.	M	D	

Table 1.--Records of wells in the Monroeville area, Ala.--Continued

Well no.	Location	Owner	Type of well	Depth of well (ft.)	Diameter of casing (in.)	Depth of casing (ft.)	Type of casing	Principal water-bearing formation	Water level		Date of measurement	Method of lift	Use	Remarks
									Elevation of MP (ft.)	Water level below (-) MP (ft.)				
90	SE¼SE¼ sec. 29, T. 7 N., R. 8 E.	Curtis McBride	Dug	23.0	36	23.0	W	Pc	200±	19.4	Apr. 9, 1953	M	D,S	Supplies water for 7 families.
91	SW¼NW¼ sec. 34, T. 7 N., R. 8 E.	Joe Howard Brantley	B	31.8	9	31.8	W	Pc	265±	21.8	do.	M	D,S	
92	NE¼SW¼ sec. 36, T. 7 N., R. 7 E.	City of Monroeville	D	120.0	10	--	S	Eo	414	60.0	Feb. 26, 1952	--	N	Known as Ice House well; former observation well.

Table 2.--Chemical analyses, in parts per million of water from selected wells in the Monroeville area.
(Analysis of water from well C-4 by Southern Testing Laboratories, Inc.;
all other analyses by U. S. Geological Survey)

Well no.: Numbers correspond to those in plate 1 and table 1.
Water-bearing formations: En, Nanafalia formation; Etu-En, Tuscahoma sand and Nanafalia formation undifferentiated; Egl, Gosport sand and Lisbon formation undifferentiated; Eo, Ocala limestone; Omrb, Marianna limestone and Red Bluff clay (limestone facies) undifferentiated; Obmg, Glendon limestone and marl members of Byram formation; Pc, Citronelle formation.

Well no.	Owner	Water-bearing formation	Depth of well (ft.)	Date of collection	Temperature (°F.)	Iron (Fe)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	pH	Dissolved solids	Hardness as $CaCO_3$
C- 4	City of Monroeville	Egl	438	June 13, 1950	--	1.3	94.5	2.0	7.1	--	--	7.6	175	140
DT-1	do.	Egl	101-147	Oct. 3, 1951	68	.09	178	9.2	3	0.2	0.2	7.9	195	135
DT-1	do	Etu-En	1,065-1,160	Nov. 14, 1951	82	.04	560	29	109	1.6	8	8.6	871	19
DT-1	do.	En	1,165-1,213	Nov. 21, 1951	83.5	.02	573	11	280	1	1.2	8.5	1,010	16
ST-9	U. S. Geol. Survey	Omrb	160	Feb. 13, 1952	69	.04	124	3.5	3.8	0	5.5	7.4	126	108
1	Francis Johnson	Eo	148	Apr. 29, 1952	--	.19	285	1	5	1	1.6	7.7	--	264
20	M. B. Petty	Obmg-Omrb	204	do.	--	.46	92	1	4.2	2	5	7.3	--	83
28	T. A. Emmons	Pc	62	Apr. 30, 1952	--	.44	4	1	3.8	1	21	6.3	--	17
29	J. F. Jackson	Pc	105	Apr. 29, 1952	--	4.8	26	2	4	1	5	6.5	--	24
30	H. R. Carter	Obmg	105	do.	--	.40	148	3	2.8	.1	5.4	8	--	138
33	Fred Sheffield	Obmg	100	do.	--	.84	150	2	2	2	3.6	8.1	--	138
36	Monroe Lumber Co.	Pc	95	Apr. 30, 1952	72	.23	8	2	6.8	2	7.7	6.5	--	16
77	Bethlehem Industrial School	Egl	260	Apr. 29, 1952	--	.28	57	1	6.5	.1	4.4	7.4	--	61
78	Van Whiting	Egl	300	do.	--	1.2	99	2	3.2	.1	3.6	7.4	--	95
82	Vanity Fair Mills	Egl	430	do.	69.5	.36	160	5	4	.2	8	7.9	--	147
84	Robinson Harper	Omrb	140	Apr. 30, 1952	71.5	.46	135	2	3	1	1.2	7.7	--	118
86	Charlie Stevens	Egl	250	Apr. 29, 1952	--	.8	102	1	5.2	.2	5.4	7.4	--	102

PLATE 4
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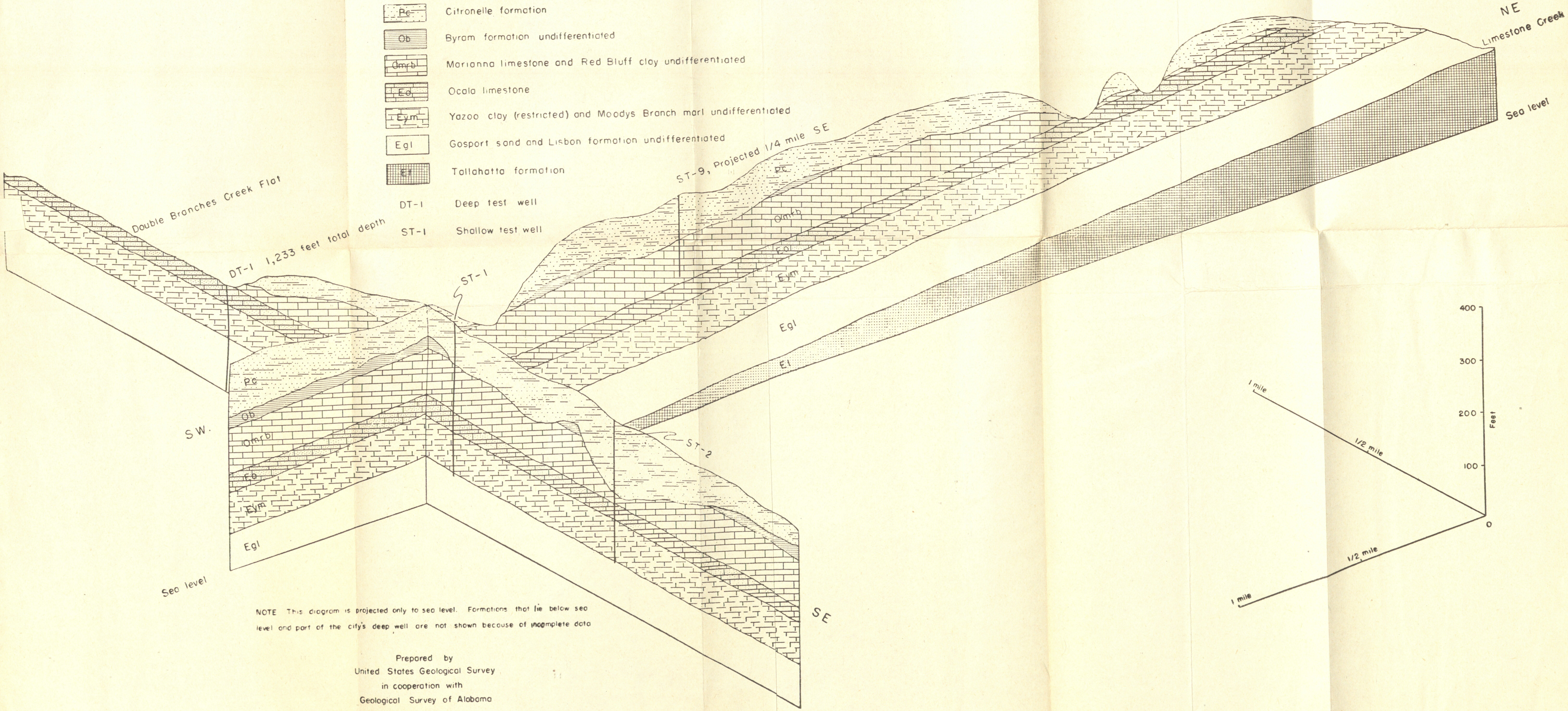
FENCE DIAGRAM OF MONROEVILLE AND VICINITY, ALABAMA


Double Branches Creek Flat
DT-1 1,233 feet total depth
ST-1
ST-9, Projected 1/4 mile SE
NE
Limestone Creek
Sea level
S.W.
Pc
Ob
Omrb
Eo
Eym
Egl
Et
ST-2
SE
Sea level
400
300
200
100
0
Feet
1 mile
1/2 mile
1/2 mile
1 mile

EXPLANATION

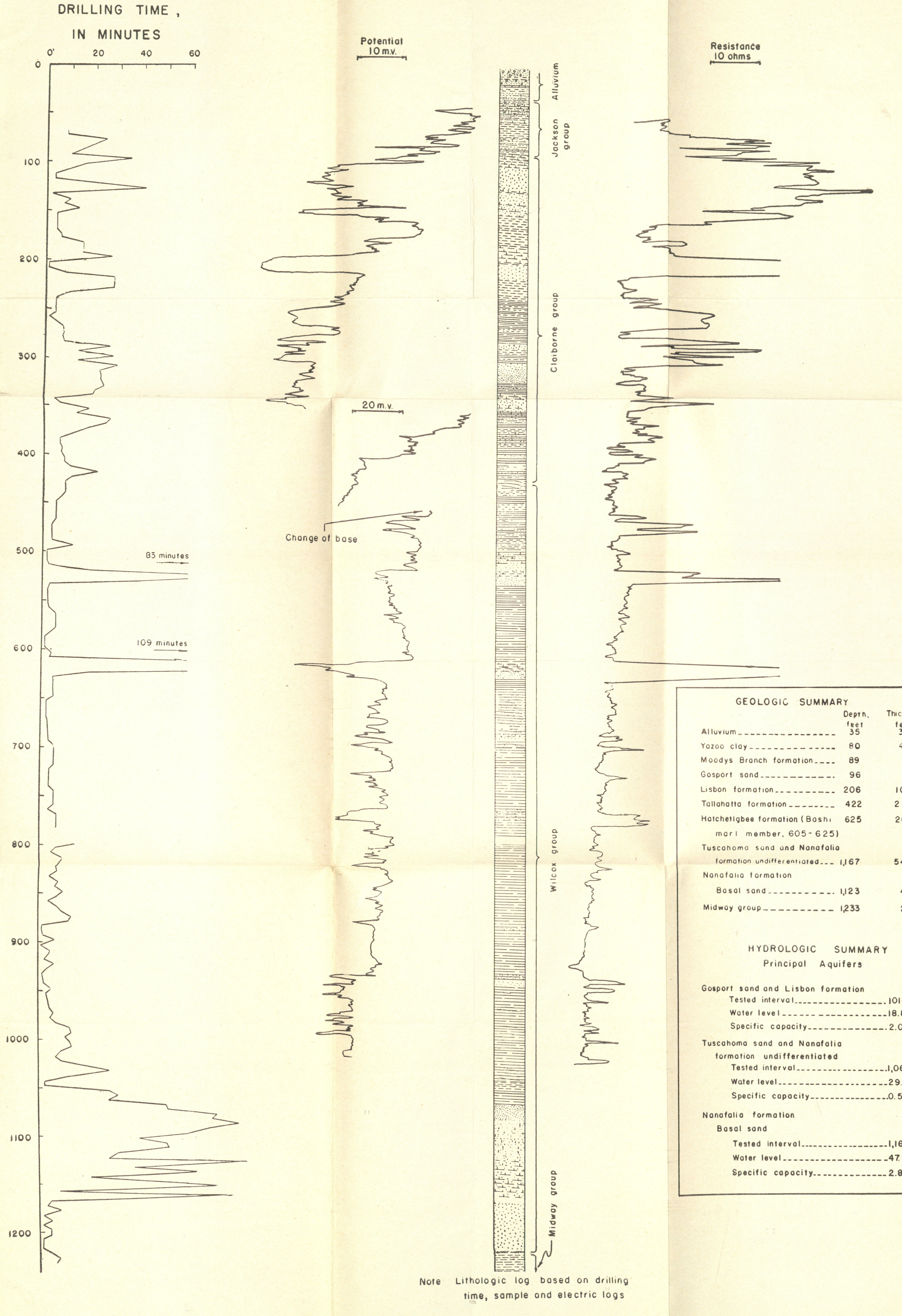
Pc	Citronelle formation
Ob	Byram formation undifferentiated
Omrbl	Marianna limestone and Red Bluff clay undifferentiated
Eo	Ocala limestone
Eym	Yazoo clay (restricted) and Moodys Branch marl undifferentiated
Egl	Gosport sand and Lisbon formation undifferentiated
Et	Tallahatta formation
DT-1	Deep test well
ST-1	Shallow test well

NOTE This diagram is projected only to sea level. Formations that lie below sea level and part of the city's deep well are not shown because of incomplete data

Prepared by
United States Geological Survey
in cooperation with
Geological Survey of Alabama
and
City of Monroeville, Alabama

John B. Ivey
U.S. Geological Survey 1952

PLATE 3
Geological Survey of Alabama—Bulletin 66



Note Lithologic log based on drilling time, sample and electric logs

GEOLOGIC SUMMARY

	Depth, feet	Thickness, feet
Alluvium	35	35
Yazoo clay	80	45
Moodys Branch formation	89	9
Gosport sand	96	7
Lisbon formation	206	109
Tallahatta formation	422	217
Hatchetigbee formation (Bashi marl member, 605-625)	625	203
Tuscahoma sand and Nanafalia formation undifferentiated	1,167	542
Nanafalia formation		
Basal sand	1,123	46
Midway group	1,233	20

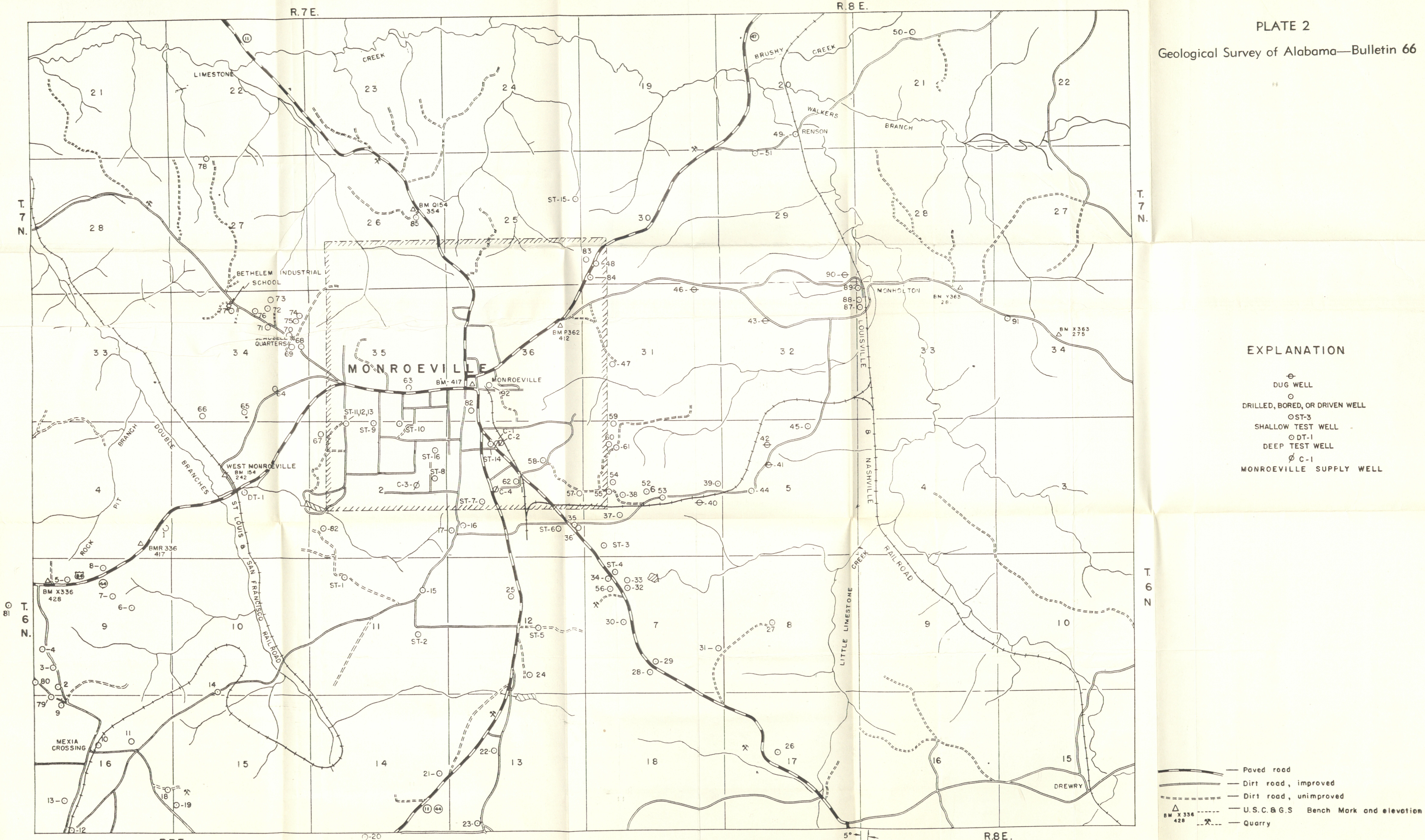
HYDROLOGIC SUMMARY
Principal Aquifers

Gosport sand and Lisbon formation	
Tested interval	101-147 ft.
Water level	18.8 ft.
Specific capacity	2.01 g.p.m./ft.
Tuscahoma sand and Nanafalia formation undifferentiated	
Tested interval	1,065-1,160ft.
Water level	29.2 ft.
Specific capacity	0.52 g.p.m./ft.
Nanafalia formation	
Basal sand	
Tested interval	1,166-1,214 ft.
Water level	47.0 ft.
Specific capacity	2.87 g.p.m./ft.

Lithologic, drilling time, and electric logs of test well DT-1 showing principal aquifers in NW 1/4 SE 1/4 sec. 3, T. 6 N., R. 7 E.

PLATE 2

Geological Survey of Alabama—Bulletin 66


R.7 E.
R.8 E.
T. 7 N.
T. 6 N.
MONROEVILLE
WEST MONROEVILLE
LIMESTONE
BETHELEM INDUSTRIAL SCHOOL
BLACKWELL QUARTERS
MONHOLTON
RENSON
DREWRY
MEXIA CROSSING
BRUSHY CREEK
WALKERS BRANCH
ROCK PIT BRANCH
DOUBLE BRANCHES
LITTLE LIMESTONE CREEK
ST LOUIS & SAN FRANCISCO RAILROAD
LOUISVILLE & NASHVILLE RAILROAD
BM Q154 354
BM P362 412
BM-417
BM Y363 28
BM X363 275
BM 154 242
BMR 336 417
BM X336 428
EXPLANATION
DUG WELL
DRILLED, BORED, OR DRIVEN WELL
ST-3 SHALLOW TEST WELL
DT-1 DEEP TEST WELL
C-1 MONROEVILLE SUPPLY WELL
Paved road
Dirt road, improved
Dirt road, unimproved
BM X336 428 U.S.C.&G.S Bench Mark and elevation
Quarry

MAP OF MONROEVILLE AND VICINITY, ALABAMA
SHOWING LOCATION OF WELLS

e - Adopted from aerial photographs
with symbol letters AUV for 1951.

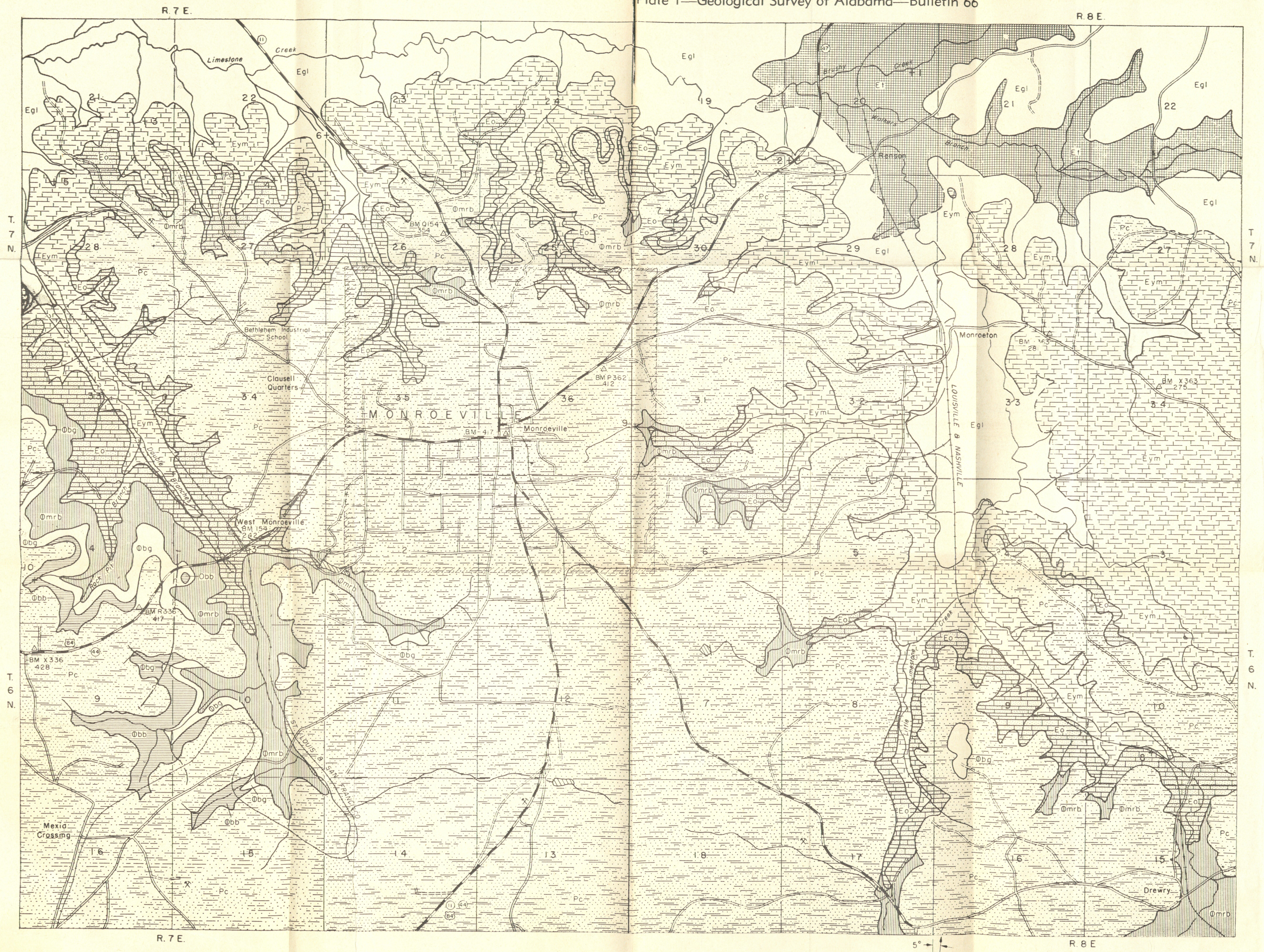
1 0 1 2 Miles

5°
True North
Magnetic North

Approximate Mean
Declination-1944

Prepared
by
United States Geological Survey
in cooperation with
Geological Survey of Alabama
and the
City of Monroeville, Alabama

Plate 1—Geological Survey of Alabama—Bulletin 66


R. 7 E.
R. 8 E.
T. 7 N.
T. 6 N.
Limestone Creek
Brushy Creek
Walkers Branch
Ranson
Double Branches
Rock Pit Branch
Limestone Creek
Bethlehem Industrial School
Clausell Quarters
MONROEVILLE
Monroeville
West Monroeville
Monroeton
Mexia Crossing
Drewry
LOUISVILLE & NASHVILLE
ST. LOUIS & SAN FRANCISCO
BM Q154 354
BM P362 412
BM 47
BM 154 222
BM R336 417
BM X336 428
BM 363 28
BM X363 275
Egl
Et
Eo
Eym
Pc
Φmrb
Φbg
Φbb
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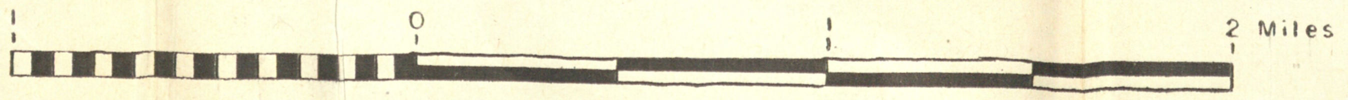
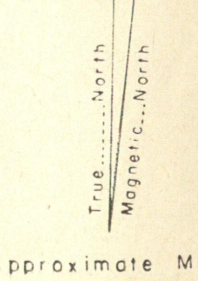
GEOLOGIC MAP OF MONROEVILLE AND VICINITY, ALABAMA

BY
JOHN B IVEY
U S GEOLOGICAL SURVEY
1952

Note - Adapted from aerial photographs with symbol letters AUV for 1938




5°
True North
Magnetic North

Approximate Mean
Declination - 1944

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EXPLANATION

TERTIARY

Pliocene

Pc

Citronelle formation

Gravel, sand, and variegated clay with local limonite - cemented conglomerate Includes Miocene sands and clays mapped by others Sand and gravel beds good aquifers where clay not present

Unconformity

Oligocene

Φbb
Φbg

Byram formation
(Bucatunna clay member, marl and Glendon limestone members)

Bucatunna clay member dark-blue to brown, weathering to light-tan, blocky, locally very fossiliferous and glauconitic
Marl member limestone, orange, hard, crystalline, fossiliferous, containing occasional solution cavities; mapped with the Glendon limestone member Lower part of Glendon member buff to white, hard, fossiliferous, containing numerous solution cavities Bucatunna clay member not an aquifer, marl member and Glendon limestone member good aquifers where well-developed solution cavities occur

Φmrb

Marianna limestone and Red Bluff clay (limestone facies) undifferentiated

Marianna limestone cream-colored, soft, very fossiliferous
Red Bluff clay (limestone facies) cream-colored, finely glauconitic, fossiliferous, basal portion containing phosphatic nodules and phosphatic replacements of fossils, mapped with Marianna limestone Marianna limestone and Red Bluff clay (limestone facies) fair aquifers where well-developed solution cavities occur Base of Vicksburg group at top of Red Bluff

Eocene

Jackson group

Eo

Ocala limestone

Limestone, buff to light-brown, very sandy, containing abundant coarse glauconite and fossils A good aquifer where sand is not firmly cemented

Eym

Yazoo clay (restricted) and Moodys Branch formation undifferentiated

Yazoo clay blue-green to yellow, micaceous, sandy, sparingly fossiliferous; locally contains beds of waxy blocky clay
Moodys Branch formation (marl or limestone): marl is light blue, sandy, with scattered pebbles, glauconitic, fossiliferous; limestone is orange to brown, sandy, containing scattered quartz pebbles, glauconitic, and fossiliferous
Moodys Branch formation is mapped with the Yazoo clay Yazoo clay not an aquifer; Moodys Branch formation fair, but thin, aquifer where very sandy

Claiborne group

Egl

Gosport sand and Lisbon formation undifferentiated

Gosport sand green to blue-green, very glauconitic, and fossiliferous, upper half containing reworked fossils and quartz pebbles. Lisbon formation: marl, sand, and hard fossiliferous limestone beds, generally blue. Gosport sand mapped with Lisbon formation. Gosport sand and sand usually occurring at top of Lisbon often developed together and form a good aquifer

Et

Tallahatta formation

Clay, claystone, and sand. Claystone generally white, iron-stained, hard, siliceous, and occurs in weathered surface exposures; unweathered clay and sand beds are blue; locally sand is glauconitic. Fossils are rare

+ 3 — Measured geologic section with reference no
— Geologic boundary observed and inferred
f——f f—?—f — Fault and questionable fault
— Paved road
— Dirt road, improved
— Dirt road, unimproved
BM X336 428 — U. S. C. & G. S. Bench mark and elevation
— Quarry